MECHANICAL HANDLING

INCORPORATING 'MATERIALS HANDLING'

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## HOW OLD IS MATERIALS HANDLING?

We read somewhere recently that 'materials handling' commenced during the last war, when the United States troops arrived in this country, bringing some fork trucks and pallets. The statement went on to say that the persons or firms in Great Britain who commenced to manufacture fork trucks and pallets were the founders of a new trade known as the Materials Handling Industry.

Such statements are not only misleading but entirely incorrect. It does not really matter how old an industry is, but let us get our facts right. Screeds have been written on the definitions of materials handling, which is entirely unnecessary; there is nothing mysterious about it. It can be defined in a few words: 'materials handling is the science of rationalizing all handling and movement of materials'. The emphasis is on movement of materials.

Now, obviously, the problem of movement of materials started with Adam. But seriously, if we read of the early days of the manufacturers of equipment for our railways or our early ocean liners and, more recently, the motor industry, the pioneers of these trades or industries had their materials handling problems, and no fork trucks or pallets to help them.

Materials handling has been with us since industry commenced although it may not have been called 'materials handling'. The advent of the fork truck was one of the greatest and most important events in the history of British industry and, of course, industry throughout the world. One cannot imagine industry without them to-day, but for centuries Britain built up its industrial production on other forms of materials handling equipment. Hence, many firms who make mechanical handling equipment to-day have been doing so for 30, 40 and 50 years and, in several instances, close on a century. In other words, they have been helping industry all those years to solve its materials handling problems.

What then is the definition of mechanical handling? 'Mechanical handling is one of the means whereby a materials handling problem may be solved'. The natural tendency to-day is to solve materials handling problems by the use of mechanical handling equipment. Listen to a really good materials handling engineer from a first-class firm tell how he solved a particular materials handling problem, or read the case histories in this journal. Invariably these problems were solved with the aid of mechanical handling equipment and not one type of equipment exclusively. There is no one 'cure-all' for different handling problems.

When you hear or read about this *new* industry, forget it. It is very old, but thanks to the many live wires concerned with it to-day, it is keeping abreast of affairs with new ideas, new equipment and new broad outlook to smooth away bottlenecks, solve handling problems, and thus increase production.

*Pour les lecteurs de l'étranger*
*Für unsere ausländischen Leser*
*Para los lectores de ultramar*

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*For readers overseas*

# SOMMAIRE EN FRANÇAIS


**Préparation du minerai de fer** Page 518
*Par un rédacteur spécial*
La New Conveyor Co., Ltd., vient récemment de terminer à Ramsden Dock, Barrow-in-Furness, une installation de préparation du minerai de fer pour la Barrow Ironworks, Ltd. Cette installation a pour but de fournir du minerai de fer trié suivant une dimension appropriée pour le haut fourneau, et du minerai fin pour l'installation d'agglomération, tout en permettant aussi aux navires accostés à quai de repartir rapidement. Cette installation a eu pour résultat une très nette amélioration du niveau de rendement général de la production.

**Courroies de Transport avec côtés ondulés** Page 522
*Par J. M. Beskine, B.Sc.(Eng.)*
Ce type de courroie, inventé par M. G. Piemont, très connu en France, est actuellement fabriqué par la Dunlop Rubber Co., Ltd., en Angleterre, pour la Numec, Ltd. Ce compte rendu technique donne la description de la gamme des courroies de transport Numec, de fabrication anglaise, ainsi que des transporteurs mobiles disponibles à présent. Il indique également de brefs renseignements sur les développements futurs actuellement à l'étude.

**La manutention de la tourbe broyée dans les centrales électriques, 2ème Partie** Page 529
C'est la deuxième et dernière partie d'un grand article traitant des méthodes appliquées par l'Electricity Board of Ireland (Electricité d'Irlande), où il est surtout question des courroies va-et-vient, du stockage en plein air, des soutes à charbon pour les chaudières, d'un dispositif d'échantillonnage et l'article se termine par un choix intéressant de tableaux et de plans.

**Transporteurs pour finissage des carrosseries à Longbridge** Page 538
*Par A. G. Douglas Clease, B.Sc., A.M.I.Mech.E.*
L'usine de Longbridge, Birmingham, de l'Austin Motor Co., Ltd., est bien connue pour son équipement très moderne et hautement mécanisé, installé pour la construction économique d'automobiles en grandes quantités. Elle comporte des kilomètres de transporteurs de divers types, parmi lesquels se trouvent cinq pistes pour transporter les carrosseries au finissage.

**Manutention des matériaux et automation à la fonderie** Page 543
*Par L. Landon Goodman, B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.Mech.E.E., A.M.I.Prod.E., F.R.S.A.*
C'est le texte complet ayant servi à l'auteur pour établir sa conférence à la Section de Sheffield de l'Institute of British Foundrymen (Institut des Fondeurs Anglais). Il traite en détail de questions comme la disposition de la fonderie, la transformation et la manutention des produits et matériaux, l'étude de la production, le contrôle, les instruments, ainsi que la recherche et le developpement.

**Le chariot industriel ou une nécessité industrielle** Page 551
*Par R. J. Bunn*
A la mort de John M. Morris, la British Industrial Truck Association (Association anglaise des chariots industriels) créait un fonds commémoratif de John Morris. Une partie de ce fonds est consacrée à récompenser le lauréat d'un concours de rédaction annuel, qui peut alors se rendre à Lake Placid, aux U.S.A. pour y suivre les cours de manutention des matériaux. Voici donc le texte de la rédaction présentée par M. R. J. Bunn, qui lui a valu ce prix pour 1960.

**Noms et adresses des fabricants** Page 556
Du fait que le numéro de mai de 'Mechanical Handling', qui publiait les listes complètes des exposants au Salon (anglais) de la Manutention Mécanique, leurs adresses et leurs numéros de téléphone, a été complètement épuisé quelques jours seulement après sa parution, et que le Catalogue de cette Exposition est également épuisé, a la suite de nombreuses demandes, nous avons réimprimé dans notre numéro de juillet le Guide des Acheteurs pour les divers Matériels, extrait du Catalogue. Dans ce numéro, nous réimprimons à présent les noms et adresses des fabricants. Nous devons préciser que ces listes n'indiquent que les noms des fabricants qui exposaient au Salon, et qu'il ne s'agit pas de la liste complète des constructeurs anglais de matériel de manutention mécanique.

**Le matériel anglais à l'étranger** Page 564
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# INHALTSÜBERSICHT AUF DEUTSCH


**Eisenerzaufbereitung** Seite 518
*von einem Spezialmitarbeiter*
Kürzlich wurde von der New Conveyor Com., Ltd., im Dock von Ramsden, Barrow-in-Furness, eine Eisenerz-Aufbereitungsanlage für die Fa. Barrow Ironworks, Ltd., fertiggestellt. Zweck dieser Anlage ist es, sortiertes Eisenerz geeigneter Korngrösse für die Hochöfen zu beschaffen und gleichzeitig ein schnelles Be- und Entladen der Schiffe am Kai zu gewährleisten. Mit dieser Anlage konnte der Produktionswirkungsgrad wesentlich gesteigert werden.

**Förderbänder mit gewellten Seiten** Seite 522

*von J. M. Beskine, B.Sc.(Eng.)*

Diese Bandform, die von dem in Frankreich sehr bekannten Mon. G. Piemont erfunden wurde, wird nunmehr von der Rubber Co., Ltd., in England für die Fa. Numec, Ltd., hergestellt. Im vorliegenden technischen Bericht werden die britischen Numec-Förderbänder und die verfahrbaren Förderanlagen beschrieben, die bereits zur Verfügung stehen. Der Artikel gibt auch eine kurze Übersicht über die z.Zt. durchgeführten Weiterentwicklungen.

**Fördern von gemahlenem Torf in Kraftwerken, Teil II** Seite 529

In diesem abschliessenden Teil eines ausführlichen Artikels über die bei der irischen Elektrizitätsbehörde zur Anwendung kommenden Methoden zum Fördern von gemahlenem Torf wird den Pendeltransportbändern, Aussenlagern, Kesselhausbunkern und einer Probeentnahmevorrichtung besondere Aufmerksamkeit gewidmet. Abschliessend werden verschiedene interessante Tabellen und Listen gebracht.

**Karosseriezurichtungsstrassen in Longbridge** Seite 538

*von A. G. Douglas Clease, B.Sc., A.M.I.Mech.E.*

Das Werk der Austin Motor Co., Ltd., in Longbridge, Birmingham, ist für seine äusserst modernen und hochmechanisierten Einrichtungen für die wirtschaftliche Grossserienproduktion bekannt. Die Gesamtlänge der Förderanlagen verschiedenster Art beläuft sich auf viele Kilometer. Unter ihnen befinden sich die hier gezeigten Karosseriezurichtungsstrassen.

**Förderanlagen und Automatisierung in der Giesserei** Seite 543

*von L. Landon Goodman, B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.Mech.E.E., A.M.I.Prod.E., F.R.S.A.*

Dies ist das volle Manuskript, das dem Vortrag des Verfassers in der Filiale Sheffield des Institute of British Foundrymen (Verband britischer Eisengiesser) zu Grunde lag. Es befasst sich ausführlich mit Fragen der Giessereianordnung, Materialverarbeitung und Förderung, Produktionsplanung, Steuerung, Instrumentierung Forschung und Entwicklung.

**Flurfördergeräte—eine industrielle Notwendigkeit** Seite 551

*von R. J. Bunn*

Beim Tode von John M. Morris gründete die 'British Industrial Truck Association' den 'John Morris Gedächtnisfonds'. Als Teil dieser Stiftung wird jährlich ein Aufsatzwettbewerb abgehalten, dessen Gewinner zur Teilnahme am fördertechnischen Kursus in Lake Placid, U.S.A., berechtigt ist. Beim vorliegenden Artikel handelt es sich um das preisgekrönte Referat von 1960, das von R. J. Bunn verfasst wurde.

**Namen und Adressen von Herstellerfirmen** Seite 556

Da die Mai-Ausgabe von Mechanical Handling, welche umfassende Listen von Ausstellern auf der letzten Fördertechnischen Ausstellung, deren Adressen und Telefonnummern brachte, schon wenige Tage nach der Veröffentlichung völlig ausverkauft und der Ausstellungskatalog ebenfalls bereits vergriffen ist, veröffentlichten wir auf Grund zahlreicher Anfragen in unserer Juliausgabe einen Nachdruck des Aussteller-Warenverzeichnisses aus dem Katalog. In der vorliegenden Ausgabe bringen wir einen Nachdruck der Namen und Adressen der Herstellerfirmen. Es wird betont, dass diese Listen nur die Namen der auf der Ausstellung vertretenen Firmen erfassen und kein komplettes Verzeichnis britischer Hersteller fördertechnischer Anlagen darstellt.


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# SUMARIO EN ESPAÑOL

**Preparación del mineral de hierro** Pág. 518

*Por un Corresponsal especial*

Ha sido terminada recientemente por la New Conveyor Com., Ltd., en Ramsden Dock, Barrow-in-Furness (Inglaterar), una planta de preparación de mineral de hierro para la Barrow Ironworks, Ltd. El objeto de dicha planta es proporcionar mineral de hierro clasificado en un tamaño adecuado para el alto horno, y mineral fino para la planta de sinterización, permitiendo al mismo tiempo una rotación rápida de los barcos en el muelle. Esta instalación ha tenido por efecto una considerable mejora en la eficiencia productiva de conjunto.

**Transportadores de cinta con lados ondulados** Pag. 522

*Por J. M. Beskine, B.S.(Eng.)*

Esta forma de cinta, que fué inventada por G. Piemont, muy concoido en Francia, la está produciendo ahora la Dunlop Rubber Co., Ltd., en Inglaterra para la Numec, Ltd. En el presente informe técnico viene descrito el surtido de los transportadores de cinta Numec hechos en la Gran Bretaña, así como los transportadores móviles que existen en la actualidad. Contiene también breves datos de otros adelantos que se están realizando.

**Manipulación de turba cortada en las centrales eléctricas Parte II** Pág. 529

En esta parte final de un extenso artículo que trata de los sistemas utilizados por la Junta de Suministro de Electricidad de Irlanda se destacan las cintas de conexión, el almacenaje al exterior, las carboneras de las casas de calderas, y un dispositivo de clasificación, terminando con una sección de interesantes tablas y gráficos.

**Pistas de acabado de carrocerías en Longbridge** Pág. 538

*Por A. G. Douglas Clease, B.Sc., A.M.I.Mech.E.*

La fábrica de The Austin Motor Co., Ltd., situada en Longbridge (Birmingham), es muy conocida por el equipo sumamente moderno y altamente mecanizado que hay instalado en ella para la producción económica de automóviles en grandes cantidades. Tiene muchos kilómetros de transportadores de varios tipos, y entre ellos figuran cinco pistas para el acabado de las carrecerías.

**Movimiento de materiales y automatización en la fundería** Pág. 543

*Por L. Landon Goodman, B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.Mech.E.E., A.M.I.Prod.E., F.R.S.A.*

Este es el texto completo en que se basó el autor para la conferencia que pronunció ante la sección de Sheffield del Instituto de los Fundidores Británicos. Trata en detalle de cuestiones tales como la disposición de las instalaciones de una fundería, procesamiento y manipulación de materiales, diseño de productos, control, instrumentos e investigación y perfeccionamiento.

**La carretilla industrial o la necesidad imprescindible** Pág. 551

*Por R. J. Bunn*

Al fallecer John M. Morris, The British Industrial Truck Association constituyó un Fondo a la Memoria de John Morris. Se celebra cada añño, como parte de dich fondo, una competicion de ensayos cuyo ganador tiene derecho a asistir al Curso de Manipulación de Materiales de Lake Placid (Estados Unidos). Aquí aparece el ensayo que ganó en 1960, siendo el autor R. J. Bunn.

**Nombres y direcciones de fabricantes** Pág. 556

Como el número de Mayo de Mechanical Handling, en el que figuraban listas completas de los expositores de la Exposición del Manipuleo Mecánico, con sus direcciones y números de teléfono, se agotó en su totalidad unos días después de publicarse, y el catálogo de dicha Exposición también está agotado, hemos reimpreso, obedeciendo a numerosas peticiones, la Guía del Comprador de Equipos extraída del catálogo, la cual aparece ahora en nuestro número de Julio. Reimprimimos los nombres y direcciones de los fabricantes. Se pone de relieve que estas listas son las de los fabricantes que participaron en la Exposición, sin que constituyan una lista completa de los fabricantes ingleses de equipos de manipulación mecánica.


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By a Special Contributor

# IRON ORE PREPARATION

ABOVE, RIGHT
*Fig. 1. General view iron ore plant at Ramsden Dock*

BELOW
*Fig. 2. No. 2 conveyor takes the ore from the bottom of the crusher house (not seen) to the top of the screen house. In the background are Nos. 3 and 4 conveyors leading to the load-out-house. The chute for discharging fines into lorries for road transport is seen at the side of the screen house*

BELOW, RIGHT
*Fig. 3. The loading-out house spans two railway tracks. Fines are loaded into rail wagons on the nearer track and larger material into those on the farther track. In the right foreground are the wagon retarders*

THERE has recently been completed by the New Conveyor Co., Ltd., at Ramsden Dock, Barrow-in-Furness, an iron ore preparation plant for Barrow Ironworks, Ltd. The purpose of the plant is to provide graded iron ore of a suitable size for the blast furnace and fine ore for the sinter plant, at the same time allowing a quick turn round of ships at the quay-side. The effect of this installation is a substantial improvement in the overall efficiency of production.

The ore is unloaded from the ships by the existing dockside cranes of the Dock Authority, which dump it behind a retaining wall. There is, therefore, no loss of time

as would be inevitable if unloading from the ships were carried out into reception hoppers, because the speed of unloading is governed purely by the crane capacity, which peaks at approximately 1,000 tons/hr, and is not dependent on the intake rate of the ore plant. Accordingly unloading is carried out expeditiously and the ship can then turn round.

From the dumps the ore is picked up by Michigan mobile shovels, each with a capacity of 120 tons/hr, that being an average figure including all travel time. If the ore is not of the type immediately required by the ore plant the shovels convey it to the stock piles, but if it is required immediately the shovels discharge their loads into the ground reception hopper for processing.

The use of Michigan shovels in this manner is the first application of them on a completely integrated plant of this nature and it has proved highly successful. It has made possible a large capital saving on plant installation, for it eliminates the alternative of an ore bridge with its heavy foundations, and reduces civil engineering costs because at this site there is made-up ground which would have necessitated extensive piling in order that a conventional fixed installation could be erected.

The ore processing plant is designed to handle both hard and soft imported ores, of a basic size of minus 8 in ring for hard and minus 18 in ring for soft ores, and of weight varying from 100 lb to 230 lb per cubic ft, at a rate of 300 tons/hr based on a weight of 150 lb per cubic ft.

From the ground reception hopper the ore falls into a Ross drop bar feeder, 30 in wide with 93 in centres, driven by a 10-h.p. electric motor. This feeds the smaller material on to No. 1 belt conveyor, the larger material falling on top of the smaller and being cushioned thereby. The conveyor deals with material up to minus 18 in ring, and has a belt 36 in wide running at 220 ft/min, driven by a 35-h.p. motor.

This No. 1 inclined conveyor carries the ore to the crusher house, where it discharges on to a vibrating bar grizzly screen measuring 42 in × 60 in and having a surface of taper bars with $2\frac{1}{2}$ in gaps between them. The drive is by a $7\frac{1}{2}$-h.p. motor. Ore which passes through the screen, i.e. less than $2\frac{1}{2}$ in, by-passes the crusher and goes direct to the No. 2 conveyor, but larger material passes into the crusher. This is a Nordberg cone crusher of extra coarse type, of 5 ft 6 in dia, and driven by a 200-h.p. motor, and it is designed to crush in one stage the hard ores to not more than $2\frac{1}{2}$ in and the soft ores to not more than 4 in, the crushed ore being discharged to No. 2 conveyor also.

It follows therefore, that this No. 2 inclined conveyor has to deal with hard ore up to $2\frac{1}{2}$ in or soft ore up to 4 in. The belt is 30 in wide and runs at 220 ft/min, being driven by a 35-h.p. motor, and it carries the ore to the screen house, discharging on to a rod desk screen, measuring 72 in × 120 in with $\frac{1}{2}$ in apertures, which is driven by a 10-h.p. motor. The finer material, that is, of size minus $\frac{1}{2}$ in, passes through the screen into the fines hopper, below which is No. 5 reversible conveyor, with a belt 36 in wide running at 50 ft/min driven by a 5-h.p. motor.

In running from right to left as seen in the general arrangement illustration, this No. 5 conveyor takes the fines to No. 3 conveyor, for transit to the loading-out house. In running from left to right the No. 5 conveyor discharges into a loading-out chute to supply lorries for road transport to the Barrow ironworks. The larger size material, which is up to 4 in soft ore or $2\frac{1}{2}$ in hard ore, passes off the screen into the oversize material hopper. From here it can be discharged through a loading-out chute into lorries, or through a vibrating feeder 48 in wide and 72 in long on to No. 4 conveyor.

The two inclined conveyors Nos. 3 and 4 take the ore to the loading-out house, which spans two rail tracks. No. 3 conveyor deals only with minus $\frac{1}{2}$ in hard or soft material and discharges into a chute over the farther of the two rail tracks, while No. 4 conveyor carrier the plus $\frac{1}{2}$ in to minus

*Fig. 4. On the left are seen three of the bays (empty) where cranes dump ore, and on the right are stockpiles. The mobile shovel in the middle distance is unloading into the ground feed hopper*

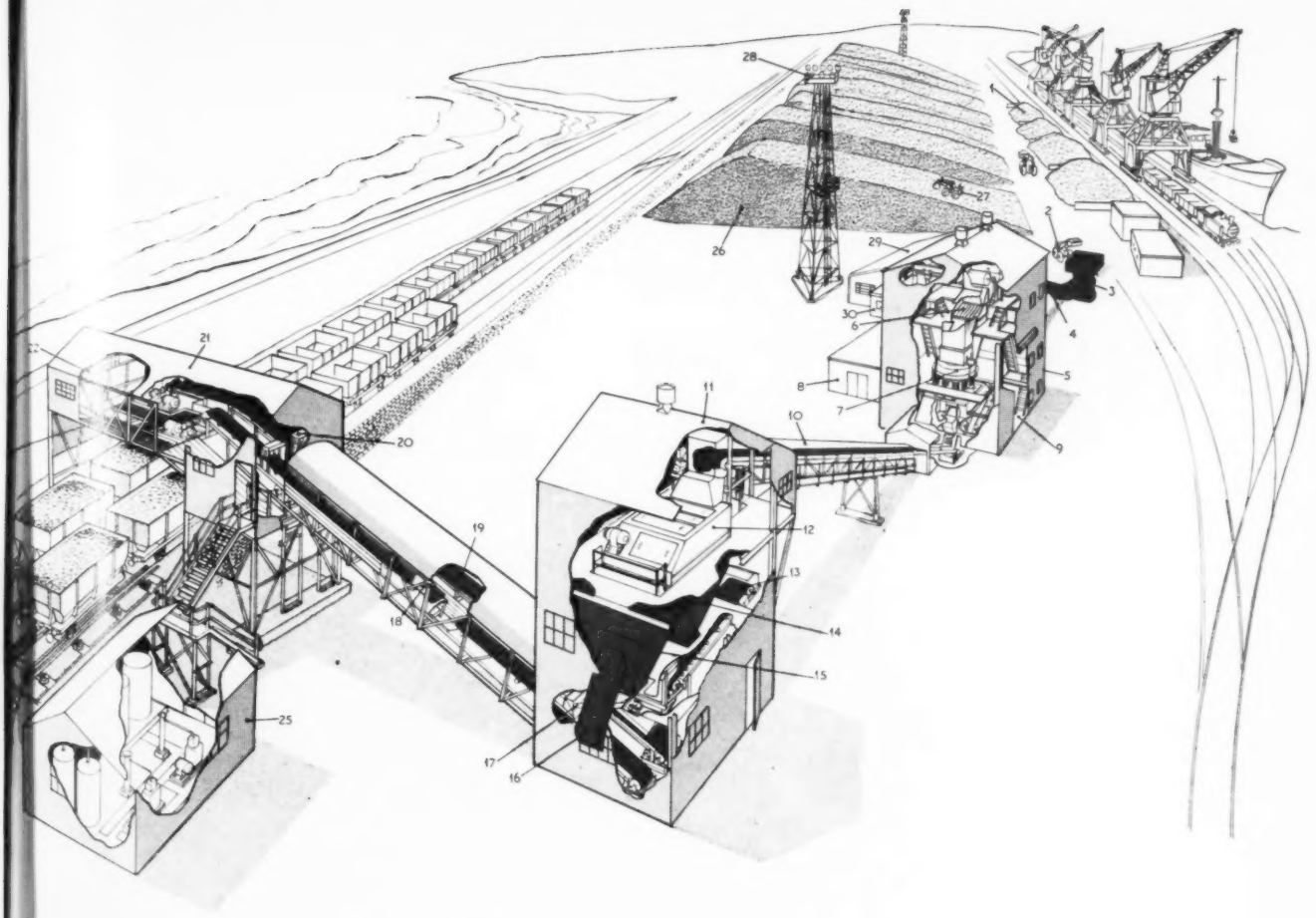
4 in soft ore or plus ½ in to minus 2½ in hard ore to a chute over the nearer rail track. These two conveyors have 24-in-wide belts running at 220 ft/min and are driven by 30-h.p. motors, and each is fitted with continuous totalizer weighers giving the overall amount of each type of material processed.

The loading-out house is a braced structure and also houses the operational control panel giving sequence operation of the plant. Emergency stop buttons and trip wires are installed at appropriate points and along the conveyors, and there are also speed and bin level controls.

As it is essential that no rail wagon receives more than a unit load of 22 tons, dial weight recorders are installed in such a position that they are readily visible to the operators and incorporate automatic cut-outs for the feed belts, operated by the belt weighers. Belts are restarted by the operators' push buttons when a further empty wagon is in position for loading. The hoppers in the screen house serve also as surge bunkers to avoid stopping and starting during the temporary hold-up of wagon loading while a loading wagon is removed and an empty one brought into position.

The wagon trains are gravity fed under the control of Metropolitan-Vickers type N air-operated wagon retarders on each rail track, the compressor house alongside the tracks having operational and stand-by compressor units. When the trains of trucks are loaded they are moved by British Railways to the works site some distance away.

Alongside the crusher house is a brick building housing the transformer and control gear of the electrical installation which is by Lancashire Dynamo & Crypto, George Ellison, Ltd., and Malcolm & Allen. All other structures are of rolled steel clad with Robertson's protected metal, black on the outside and aluminium inside. Holst & Co. were sub-contractors for the civil engineering work, including the concrete piling, and the New Conveyor Co. were the main contractors responsible for the whole scheme, including civil engineering, wiring and floodlighting of the whole site.




ABOVE
*Fig. 5. Artist's impression of the dockside ore handling and preparation plant at Ramsden Dock*

KEY to Fig. 5

1. Initial discharge pockets for dockside crane
2. Ground feed hopper
3. Drop bar feeder
4. No. 1 conveyor
5. Crusher house
6. Vibrating bar grizzly screen
7. Cone crusher
8. Transformer/control house
9. Sliding door
10. No. 2 conveyor
11. Screen house
12. Rod deck screen
13. No. 5 reversible conveyor (belt feeder)
14. Fines material hopper
15. Oversize material hopper
16. Loading-out chute
17. Vibrating hopper
18. No. 4 conveyor
19. No. 3 conveyor
20. Single idler suspension type weighers
21. Loading-out house
22. Operator's cabin
23. Open mesh flooring
24. Wagon retarders
25. Compressor house
26. Stockpile
27. Tractor shovel
28. Flood lighting towers
29. Garage
30. Mess room

BELOW
*Fig. 6. A Michigan mobile shovel has discharged ore into the ground feed hopper above the Ross drop bar feeder which delivers first the smaller and then the larger material on to No. 1 inclined conveyor*

# CONVEYOR BELTING WITH CORRUGATED SIDES

By J. M. BESKINE, B.Sc. (Eng.).

NUMEC conveyor belting is now in quantity production at Liverpool, and is available to manufacturers of fixed and mobile conveyors, for incorporation into their own machines. It is being made by the Dunlop Rubber Co., Ltd., for Numec, Ltd., a subsidiary of the Derbyshire Carriage & Wagon Co., Ltd., and is being marketed in the British Isles and other countries. Numec, Ltd., are also manufacturing specially designed mobile conveyors at their Chesterfield factory, as well as a variety of fixed general-purpose and special-purpose conveying installations, all of these machines being designed to take advantage of the exceptionally high carrying capacity of Numec conveyor belts. Typical examples of conveyor design are shown in Figs. 1 and 2.

The Numec range of conveyor belting is fully protected by current patents in Britain, France, Germany, and other important manufacturing countries, and has been manufactured in France for several years. The belting was invented by Mon. G. Piemont, who is well known in France for his successful inventive achievements and is responsible for a number of recently introduced industrial development of commercial importance.

The *Mechanical Handling* technical report which follows describes the range of British-made Numec conveyor belting and the mobile conveyors which are at present available, and gives brief details of further developments in hand. The report also gives details of Numec conveyor belt techniques and applications.

The author is indebted to Mr. E. D. Rands, a director of Numec, Ltd., to the Dunlop Rubber Co., Ltd., and to Société Commodex of Paris, for samples of belting and for opportunity to examine Numec conveyor belt and mobile conveyor design and performance data, in order to assess the practical value of the belting under present-day conditions. His opinion is that the new belting is here to stay and that it deserves to be regarded as a major advance in conveyor belt design. For example, it successfully combines the main advantages of flat belts with those of troughed belts, but is in some respects superior to either. It runs on straight idler rollers but has a nominal carrying capacity greater than that of a troughed belt of equal overall width. Furthermore, it is able to operate efficiently at high running speeds and can carry bulk materials up steeper inclinations than troughed belts. If integral crossbars are used, a Numec conveyor belt is able to work up even steeper inclinations. Many other unique characteristics could be mentioned. Thus, a Numec belt can be run on existing troughed idler systems, if Numec return idlers are fitted. And it is possible to obtain a more or less fully enclosed conveyor, somewhat akin to a zipper-type conveyor.

The economic repercussions of the quantity production of this conveyor belting should not be underestimated by

*Fig.* 1 (*left*). *A Numec standard mobile conveyor in the towing position. The conveyor belt has integral upstand-type cross-flights. Numec belts are also available without crossbars*

*Fig.* 2 (*below*). *Part of a large horizontal Numec conveyor installation, showing the fluted skirts and flat base of the belt which, in this case, is without cross-flights*

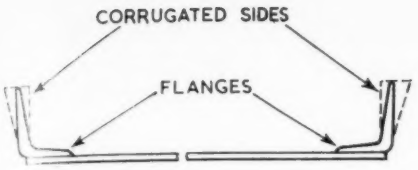



*Fig Cross-section through typical Numec conveyor belt*

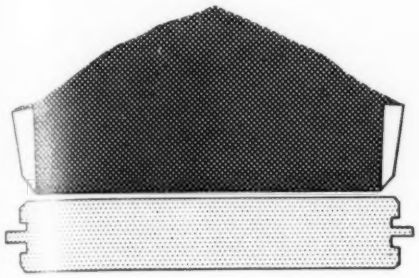


*Fig. 5. Cross-section of a Numec belt, fully loaded*

*Fig. 6. Cross-section of a troughed belt, fully loaded*

conveyor designers and manufacturers. Those of them who investigate the possibilities of marketing a range of machines with Numec belts, alongside machines with flat belts and with troughed belts, may be able to take advantage of opportunities immediately they arise. Equipment users will, most certainly, prove to be keenly interested in the claims put forward for this new development. For these reasons, the theoretical background has been discussed in detail.

**Construction**

Numec conveyor belts are of rubber and fabric construction and consist of the following functional basic elements: (*a*) a flat conveyor belt element; (*b*) left- and right-handed fluted skirt or corrugated side plate elements, complete with flanges. Each belt is, in fact, a flat conveyor belt with integral continuous sides, a type of moving hopper or bunker of approximately rectangular cross-section, and having a heaped load capacity very much greater than a troughed belt of equal overall width.

The construction is shown in Figs. 3 and 4. Cross-sections through fully loaded Numec and troughed belt conveyors, shown in Figs. 5 and 6, demonstrate the increased carrying capacity obtainable with Numec belts.

The function of the flat belt element of a Numec belt is to carry the material being handled and to transmit the working stresses set up by traction. The corrugated sides are designed to withstand the side-pressures set up by bulk materials on a fully loaded belt, and to unfold when the belt passes the end pulleys. Under side-pressure the fluted sides must not move greatly outwards from their design position, which is approximately vertical. When lapping the head or tail pulleys the sides must not come under tension, nor must they belly outwards from the vertical position.

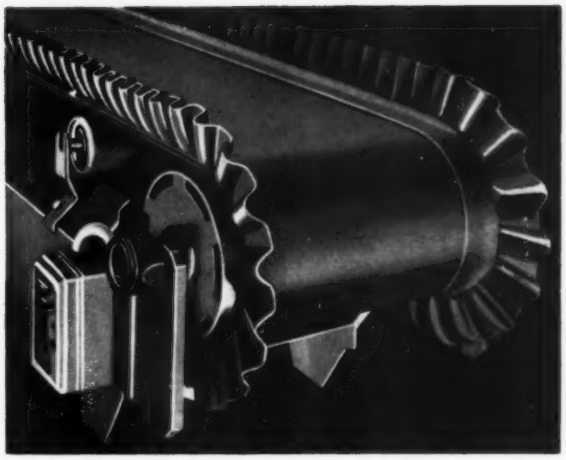
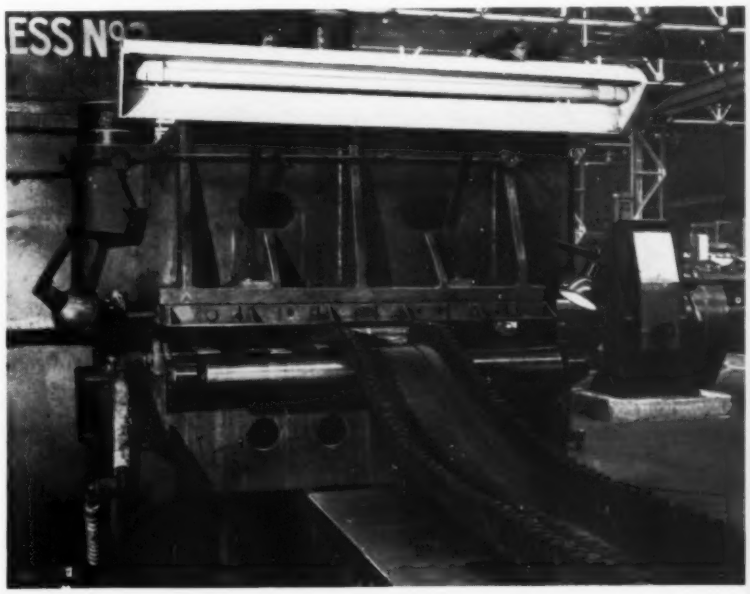


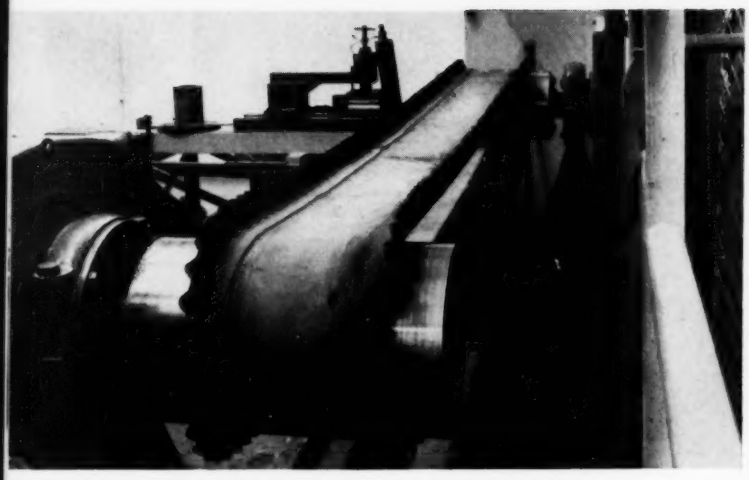
*Fig. 4. Numec conveyor belt, showing flat idler pulley and the way in which the fluted skirts unfold as the belt passes over the end pulley, providing a continuous maintenance of side support to ensure that the material being handled remains in a ribbon of constant width*

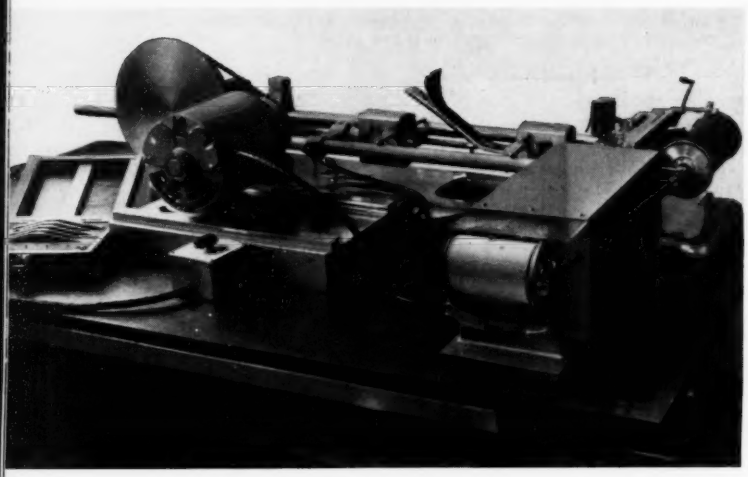
Another requirement is that of ensuring that the material being handled remains in a ribbon of constant width when leaving the belt. This is achieved by maintaining the sides approximately vertical while unfolding takes place. Fig. 7 shows one stage of fluted skirt processing during belt manufacture.

Constructionally, Numec belts have three main components: (*a*) rubber covers; (*b*) fabric carcase, and (*c*) rubber corrugated sides. The fabric is woven under strict quality control in Europe's largest belting duck factory, the Dunlop Cotton Mills at Rochdale, Lancashire. Throughout manufacture, tests are carried out to ensure that the fabric is within specification requirements. Belt production itself is carried out by the Dunlop Belting Division at Speke, Liverpool. The rubber compounds are Banbury-mixed, each batch being tested prior to release for production.

*Fig. 7. One stage in Numec belt manufacture, press consolidation of fluted skirts*







TOP
*Fig. 8. A Numec conveyor belt after 420 hours' running at 1,500 ft/min round 15-in dia pulleys on a belt testing machine*

ABOVE
*Fig. 9. Measuring the adhesion of the cover on a sample of Numec belting*

BELOW
*Fig. 10. Measuring the breaking load of a sample of Numec belting*

The fabric is impregnated with rubber compound on a frictioning calender and, in the case of heavier duty belts, an additional layer of rubber is skim-coated over the friction material. The treated fabric is then cut to the required width and length and the individual plies are built up to form the carcase or tension-carrying member of the belt.

The rubber covers are calendered to precise tolerances and applied to the face and back of the assembled carcase, and wrapped round the sides to provide full protection to the edges. The sides are formed by a patented method. All stages of belt manufacture are carried out under conditions of strict quality control, all component parts being inspected and their dimensions checked. Samples of finished belt are tested under controlled temperature and humidity conditions and to ensure satisfactory performance a series of tests is carried out as follows: (*a*) strength and elongation of belt, of individual plies, and of cover rubbers; (*b*) adhesion between plies and between covers and plies; (*c*) dynamometer tests on random samples to check belt performance under very severe operating conditions, as shown in Figs. 8, 9 and 10.

Table 1 gives details of the constructional strength of Numec beltings and also gives brief details of accelerated performance test results. The Dunlop Rubber Co., Ltd., state that, by using a special process, Numec belts are also made completely mildew-proof.

**TABLE 1**

**Typical examples of constructional strength of Numec fluted edge box-section conveyor belting, made for Numec, Ltd., by Dunlop Rubber Co., Ltd.**

| | | |
|---|---|---|
| 'A' Grade Rubber Cover, | Min. Tensile Strength | 3,500 lb/sq. in. |
| | Elongation at Break | 450 per cent |
| 'B' Grade Rubber Cover, | Min. Tensile Strength | 2,500 lb/sq. in. |
| | Elongation at Break | 400 per cent |
| 28-oz. Duck:— | | |
| | Min. Tensile Strength of Ply (Warp) | 350 lb/sq. in. |
| | Min. Tensile Strength of Ply (Weft) | 170 lb/sq. in. |
| 32-oz. Duck:— | | |
| | Min. Tensile Strength of Ply (Warp) | 400 lb/sq. in. |
| | Min. Tensile Strength of Ply (Weft) | 185 lb/sq. in. |
| Min. Adhesion of Cover to Ply, | Grade 'A' | 24 lb/sq. in. |
| Min. Adhesion of Ply to Ply, | Grade 'A' | 26 lb/sq. in. |
| Min. Adhesion of Cover to Ply, | Grade 'B' | 18 lb/sq. in. |
| Min. Adhesion of Ply to Ply, | Grade 'B' | 20 lb/sq. in. |

Accelerated Performance Tests have been carried out by the Dunlop Rubber Co., Ltd., at belt speeds between 1,500 ft/min to 2,000 ft/min, with a belt tension of 75 lb/in width, using terminal pulleys of 12 in dia, or less. These tests have shown that the following advantages characterize the Numec conveyor belting made by Dunlop:

(*a*) superior training, even when running empty;
(*b*) high resistance to cuts and tears;
(*c*) exceptionally long vulcanized splice life.

**Belt Widths**

Numec conveyor belts are available in widths ranging from 9 in to 36 in, with 2-in or 3-in high corrugated edges, in various weights of fabric from 2-ply upwards. They can be obtained in any thickness or grade of rubber cover.

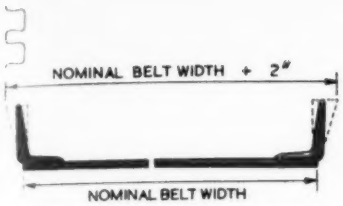



*Fig. 11. Widths of Numec belting*

**TABLE 2**

**Numec Belt Widths and other Data**

| | |
|---|---|
| **Nominal Belt Widths:** | 9 in; 10 in; 12 in; 14 in; 16 in; 18 in; 20 in; 22 in; 24 in; 26 in; 28 in; 30 in; 32 in; 34 in; 36 in |
| **Maximum Belt Width:** | **Nominal Width** + 2 in |
| In each case, height of fluted skirts can be *either* 2 in *or* | 3 in |
| In each case the following constructions are available: | |
| | 2 ply and above. |
| | Normally supplied in 28-oz. and 32-oz. duck, Grade 'A' and 'B' rubber in any thickness. |
| | Food quality in grey rubber. |
| | Can be supplied in synthetic fabrics on request. |

**TABLE 3**

**Maximum Inclinations of Numec Conveyor Belts***

| Material | Angle | Material | Angle |
|---|---|---|---|
| | deg | | deg |
| Alumina | 16 | Gravel | 22 |
| Ashes | 20 | Ore | 20 |
| Ball-bearings | 16 | Paper Pulp | 15 |
| Beet pulp | 25 | Potatoes | 12 |
| Bricks | 20 | Sacks | 35 |
| Cement | 23 | Salt | 20 |
| Charcoal (Dry) | 20 | Sand (Dry) | 17 |
| Charcoal (Wet) | 22 | Sand (Wet) | 22 |
| Cinders | 22 | Slag | 22 |
| Clay | 27 | Stones | 20 |
| Coke | 22 | Sulphur | 20 |
| Concrete | 27 | Sugar | 16 |
| Flour | 20 | Wood Chips | 27 |
| Grain | 18 | | |

* Without crossbars or flights. If these are incorporated the maximum inclinations are increased by 20 per cent or more in certain instances.

The complete range of belt widths is given in Table 2. These refer to nominal widths. As shown in Fig. 11, maximum belt width equals nominal width plus 2 in, this being due to the allowance necessary because of the sides.

Numec standard conveyor belts are covered in black rubber and are without crossbars. Belts are also available in grey rubber suitable for the handling of foodstuffs, pharmaceuticals, tobacco, etc. In addition, they can be obtained with solid rubber crossbars.

**Steep Inclinations are Permissible**

Steep inclinations are permissible when using Numec conveyor belts without crossbars, the increased gradient being rather more than 10 per cent when compared with a troughed belt. If crossbars are employed, the gradient can be further increased by something greater than 20 per cent, depending upon the nature of material handled.

The good performance of the belts when working with inclined conveyors is mainly due to the buttress effect of the sides, which act in a manner akin to flights when fully loaded. In practice, of course, the actual angle of inclination will vary not only with the material handled, but also with its granual size. As the size of unit pieces of material increases, the wedging effect becomes accentuated. Furthermore, belt width influences maximum angle of inclination, and width must be considered in relation to granularity and type of material. The effective wedging action at steep gradients is increased by reduction of internal width between fluted skirts. However, for larger pieces of material, this effect is probably negligible.

As a general guide to performance at steep inclinations, the figures in Table 3 may be of interest. These give maximum gradients for a range of bulk materials, ignoring the effect of belt width and the exact size of material handled.

Typical examples of Numec conveyor belts working at steep inclinations are shown in the photographs, Figs. 12 to 14. Fig. 12 shows a mobile conveyor being loaded with fuel nuts for stockpiling. The steep angle of inclination is apparent from the illustration, which also clearly shows the buttressing effect exerted by the fluted skirts of the belt, enabling full belt capacity to be handled without spillage.

**Handling Capacity**

The handling capacity of a Numec conveyor belt without crossbars can be calculated from consideration of basic principles, as follows.

Let the diagram, Fig. 15, represent the cross-section of a fully loaded Numec belt. The material being handled will occupy a cross-sectional area consisting of the rectangular $A$ and the segment $B$, the latter being for all practical purposes approximately circular. Then, the included angle between the horizontal $XX$ and the tangent $XY$ will be a characteristic of the material being handled, being the natural inclination of the material at the point of contact with the fluted skirt side support. This angle will vary according to the tendency of the material to spread itself out when piled in a heap and, in general, can be taken as being about 20 deg. This depth determines the maximum height of material which can be carried without spillage despite the movement and vibration of the belt in motion.

From this it follows that the maximum volumetric capacity of a Numec conveyor belt per ft run is constant, irrespective of material handled or belt speed.

Hence, the volumetric carrying capacity is directly proportional to belt speed, and the carrying capacity in terms of weight is directly proportional to belt speed and to the density of the material in question.

And, as long as the maximum angle of inclination is not exceeded for the material being handled, the carrying capacity is also proportional to the cosine of the angle of inclination. If the angle of inclination is excessive, the belt will not run to full capacity and strict proportionality will no longer occur. However, in such a case it is very unlikely that a belt without crossbars would have been selected in the first place.

One further consideration could be brought into account. If a Numec belt with crossbars is used, the general considerations given above still apply—provided that a correction be made for the reduced volumetric capacity of the belt and for the slightly increased buttress effect due to additional bearing surfaces, i.e. the flights and dividers, etc.

*Fig.* 12. *Numec mobile conveyor being loaded with solid fuel nuts. Note steep angle of inclination and full belt capacity and absence of spillage due to buttress of fluted skirts of conveyor belt*

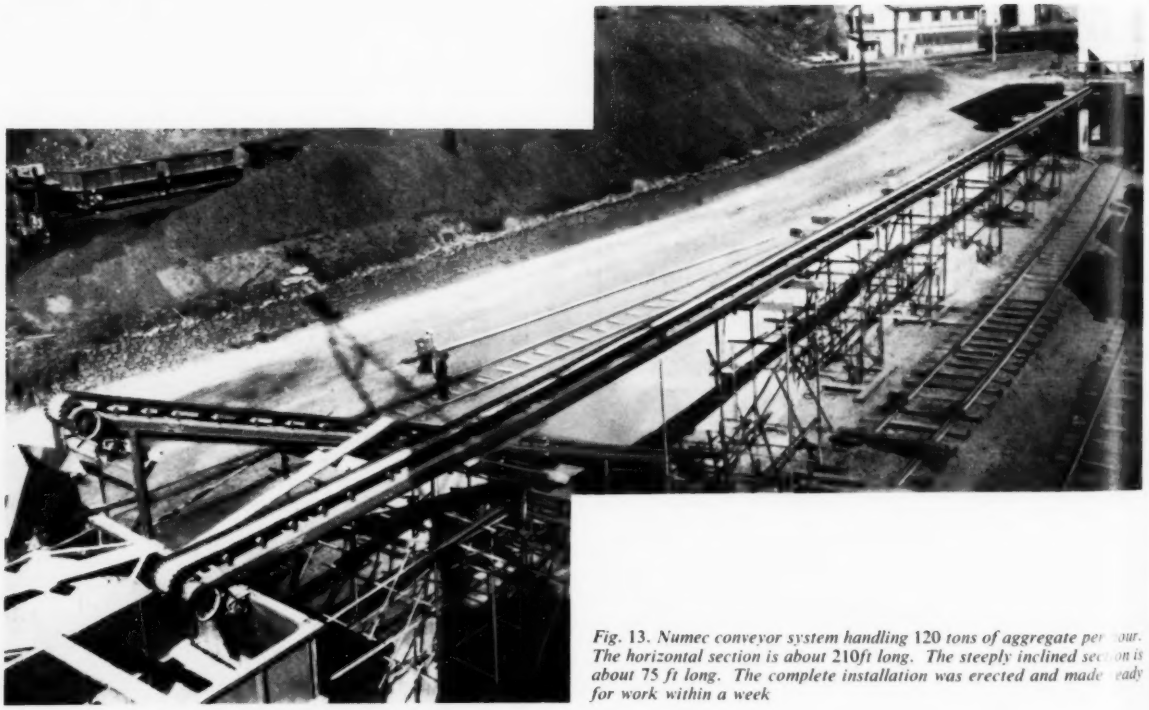


*Fig.* 13. *Numec conveyor system handling* 120 *tons of aggregate per hour. The horizontal section is about* 210*ft long. The steeply inclined section is about* 75 *ft long. The complete installation was erected and made ready for work within a week*

It should be remembered that the maximum angle of inclination will be increased for the material being handled.

The nominal volumetric carrying capacity of a Numec conveyor belt, V cu. ft/hr, is given in Table 4 for horizontal conveyors running at a nominal speed of 1 ft/min. Figures are given for: (*a*) controlled uniform loading; (*b*) controlled non-uniform loading, and (*c*) uncontrolled loading.

These figures are based upon theoretical investigations backed up by laboratory performance trials and are given for Numec belt widths of 9 in to 30 in.

One important point to note is that the density of the material on the belt means exactly what it says, it refers to the density of the material being handled, as measured on the belt, in a hopper, etc.

When calculating conveyor belt capacity special attention must be paid to (*a*) estimation of instantaneous carrying capacity, and (*b*) apparent density of material being handled. The instantaneous carrying capacity can vary considerably due to variations in methods of loading and to avoid overloading the conveyor the nominal width and

skirt height should be selected to suit maximum instantaneous capacity, and for this reason use should be made of the three loading conditions given in Table 4. Practical experience indicates that if loading by means of a belt feed or vibrator is used, the instantaneous supply of material to the conveyor belt can be 10 per cent greater than the mean supply. Similarly, if no feeding device is used at all, the instantaneous supply can rise to as much as 25 per cent more than the mean supply. For similar reasons variations in apparent density of material on the conveyor belt may occur. Generally, this density is less than the normally accepted figure for the material being handled. If the

**TABLE 4**

**Nominal Volumetric Carrying Capacity of Numec Conveyor Belts in Horizontal Position (Nominal Belt speed = 1 ft/min)**

| Nominal Belt Width (in) | Nominal volumetric carrying capacity, V, in cu. ft/hr, for loading conditions given below: | | | | | |
|---|---|---|---|---|---|---|
| | Controlled Uniform Loading | | Controlled non-Uniform Loading | | Uncontrolled Loading | |
| | 2 in skirt | 3 in skirt | 2 in skirt | 3 in skirt | 2 in skirt | 3 in skirt |
| 9 | 7·0 | 8·8 | 6·3 | 8·0 | 5·7 | 7·2 |
| 10 | 7·8 | 10·3 | 7·2 | 9·2 | 6·3 | 8·2 |
| 12 | 9·5 | 12·5 | 8·5 | 11·3 | 7·7 | 10·0 |
| 14 | 11·7 | 15·3 | 10·5 | 13·8 | 9·3 | 12·3 |
| 16 | 13·8 | 18·3 | 12·5 | 16·5 | 11·0 | 14·7 |
| 18 | 16·2 | 21·7 | 13·5 | 19·5 | 13·0 | 17·3 |
| 20 | 19·2 | 25·0 | 17·3 | 22·5 | 15·3 | 20·0 |
| 24 | 25·5 | 32·2 | 23·0 | 29·0 | 20·3 | 25·7 |
| 26 | 28·7 | 36·8 | 25·8 | 32·3 | 23·0 | 28·7 |
| 30 | 35·8 | 43·2 | 32·3 | 38·8 | 28·7 | 34·5 |

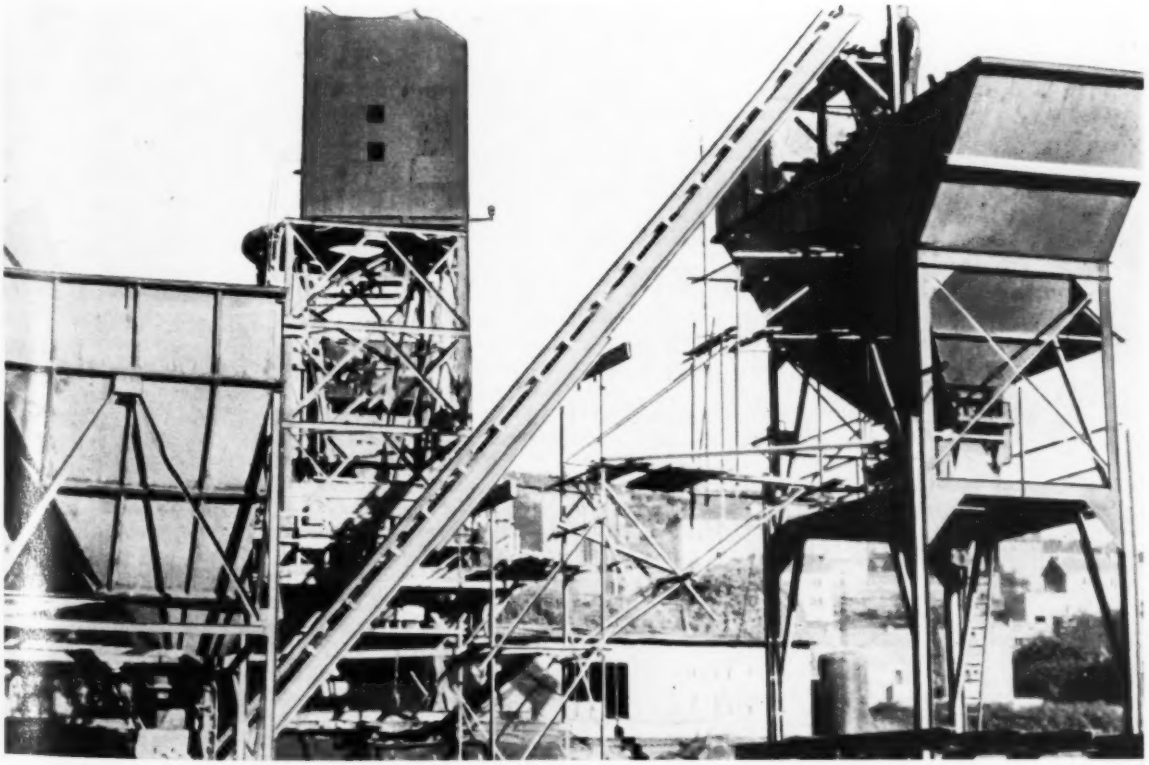
**TABLE 5**

**Percentage Handling Capacity Increase of Numec Conveyor Belts in comparison with Conventional Troughed Belts**

| Nominal width of Belt (Inches) | Numec Belt with 2 in skirts | Numec Belt with 3 in skirts |
|---|---|---|
| | per cent | per cent |
| 9 | 126 | 184 |
| 10 | 105 | 171 |
| 12 | 76 | 131 |
| 14 | 63 | 112 |
| 16 | 53 | 103 |
| 18 | 45 | 94 |
| 20 | 34 | 75 |
| 24 | 21 | 53 |
| 26 | 13 | 44 |
| 30 | 4 | 25 |

Notes: In all cases the conveyor belts are horizontal. If the conveyor belts are inclined, the percentage increase due to use of a Numec fluted skirt box-section belt, will be even greater.

*Fig. 14. The angle of inclination of this Numec conveyor is 60 deg and it is designed to feed a mixer with 50 tons of aggregate per hour. The conveyor is self-supporting*



material drops from conveyor to conveyor, the bulk volume increases and the density falls.

If a Numec conveyor belt with crossbars, dividers, etc., is being used, the actual carrying capacity can be found from a formula such as the following:

$$W = K.\frac{V\ v\ \mathrm{Cos}\ \theta}{2240} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where K is a constant for the particular belt design employed, being determined by the dimensions of the belt and the crossbars, dividers, etc., v is the belt velocity, $\theta$ the belt inclination, and V the nominal volumetric carrying capacity.

**Comparative Performance**

It may be necessary to compare the handling capacity of a Numec conveyor belt with a troughed belt of equal overall width. This can be done from the figures given in Table 5, which show the percentage increase in handling capacity obtained by using a Numec belt.

If the belts being compared are inclined, then the advantage is even more heavily in favour of a Numec belt, due to maintenance of load capacity with this belt and dropping off in capacity of the troughed belt as the inclination increases. It will be seen that the ratio of leading dimensions of a Numec belt, i.e. the ratio of nominal belt width to depth of skirt, exercises an important influence on the increase in comparative handling capacity, which is to be expected, in view of the increased packing or buffering effect of narrower belt widths. Howevever, it must be remembered that for a given belt speed, the actual outputs will be lower with narrower belts.

The manufacturers claim that Numec conveyor belts generally give 50 per cent more handling capacity than troughed belts. The figures in Table 5 show that, in fact, the advantage varies from 4 per cent to as much as 185 per cent. Actually, if correct belt dimensions are selected in every case, an average figure of 50 per cent or more seems to be quite feasible.

**Maximum Running Speeds**

Certain factors do, of course, limit conveyor belt speed, whatever the design and however strong the construction. These include the effects of turbulence, relative clearance, etc. The maximum running speeds recommended by Numec, Ltd., for use with their conveyor belts are given in Table 6 for various materials and belt widths. These figures apply to joined belts as well as endless belts. However, if metal belt fasteners are employed, the makers' instructions should be followed, which may mean keeping the belt speed down to a maximum of about 250 ft/min.

**TABLE 6**

**Maximum Running Speeds Recommended for Use with Numec Conveyor Belts**

| Materials Conveyed | Nominal Belt Width | | | |
|---|---|---|---|---|
| | 8-10 in | 12-18 in | 20-26 in | 30 in |
| | V max. ft/min | | | |
| Ungraded Coal, Stones, Gravel, etc. | 300 | 300 | 300 | 400 |
| Graded Coal, Coke, etc. | 250 | 250 | 250 | 300 |
| Grain, Sand | 300 | 300 | 400-500 | 600 |
| Pulverized Coke, Heavy Abrasive Materials | 250 | 250 | 250 | 300 |
| Rough Materials in Abrasive Lumps | 200 | 250 | 300 | 350 |
| Sacks and Packages | 200-300 | 200-300 | 200-300 | 200-300 |

**Selection of Correct Belt Width**

In practice, it is generally advisable to select belt width before running speed. This is because optimum belt performance has been proved to be related to correct choice of belt width for the size of material handled, for reasons which can easily be understood from what has already been said elsewhere above. Thus, for maximum utilization of available belt carrying capacity the ratio of material size to belt width must be sufficiently low to permit application of the loading theory already discussed and illustrated by the diagram, Fig. 15. In addition, the off-loading chutes and hoppers employed with Numec belts must be wide enough and with sufficient clearances to permit regular discharge without choking or tamping.

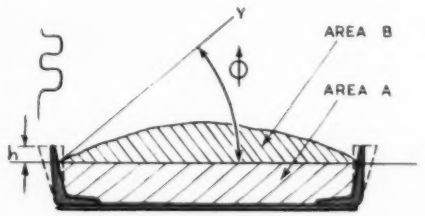



*Fig. 15. Carrying capacity of a Numec conveyor belt. (In general the angle is about 20 deg)*

Practical experience has demonstrated that the correct belt width is obtained under the following conditions: (i) when the nominal width of the Numec belt is equal to four times the size of the largest pieces of material to be conveyed, in the case of unscreened mixed bulk materials containing large pieces mixed with pulverized material; or (ii) when the nominal width of the Numec belt is equal to five times half the size of the largest pieces of material to be conveyed, in the case of screened and uniform material.

However, if application of either rule results in a nominal belt width less than about 16 in, the following rules should be used instead: (iii) make the nominal width equal to three times the size of the largest pieces of material to be handled, plus 4 in, in the case of unscreened materials containing large and pulverized materials; or (iv) make the nominal belt width equal to four times the size of the largest pieces of material to be handled, plus 4 in, in the case of screened and uniform material.

**Power Consumption**

The horsepower required to run a Numec conveyor belt, HP, is easily calculated as follows:

$$HP = P_1 + P_2 + P_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where: $P_1$ = power absorbed when running the belt unloaded.

$P_2$ = power absorbed by horizontal movement of the load on the belt.

$P_3$ = power absorbed by elevation of the load.

The total motor or engine horsepower will, of course, be greater than HP, and will include allowances for efficiency of the transmission, including speed reducers, etc., which may vary from something below 50 per cent to as much as 90 per cent, depending upon design and construction.

# HANDLING MILLED PEAT AT POWER STATIONS – PART 2

by A. G. Kelly, B.E., M.A.S.M.E., A.M.I.Mech.E., and S. F. Coakley, B.E., B.Sc.*

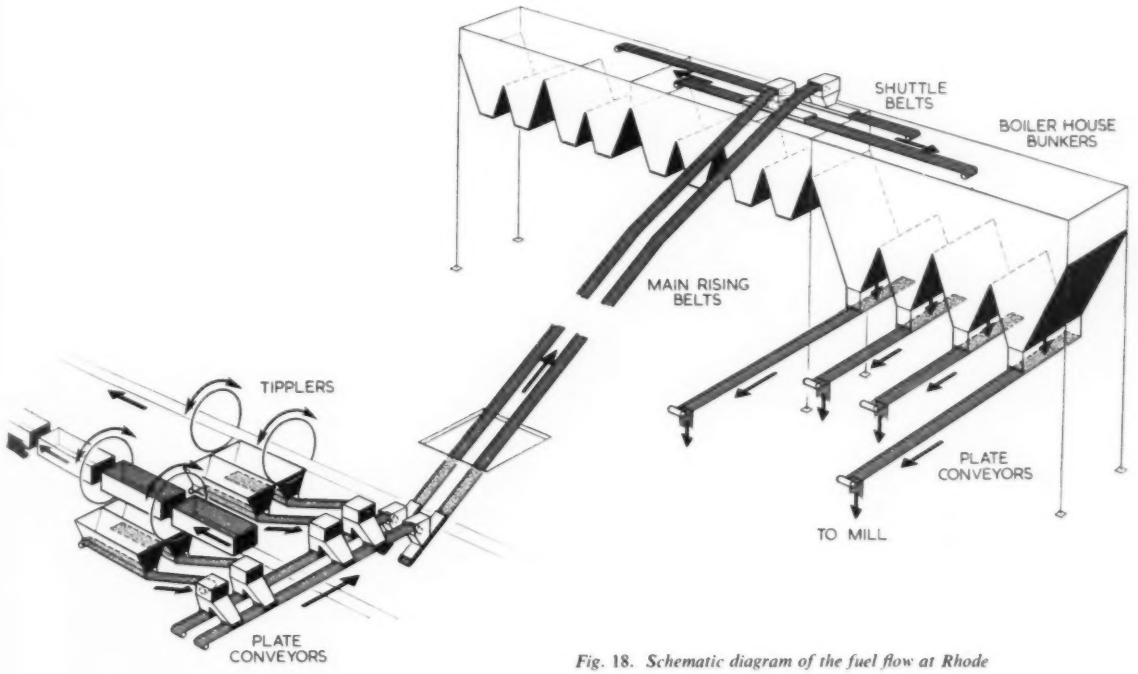



*Fig. 18. Schematic diagram of the fuel flow at Rhode*

A SCHEMATIC of the belt systems in Rhode is given in Fig. 18 and particulars of belt sizes and capacities are given in Table 3. Cross-over chutes are provided in the stations with two belt systems. Plain troughed belts have been used throughout. The belt systems are largely conventional as used with other types of fuel. The idlers are of the type that does not require greasing *in situ* but are regreased in the workshop every 3 to 5 years. The idler bearings do not need dismantling for regreasing.

Fig. 19 shows the two 47¼ in wide main belts in the rising bridge at Ferbane.

The following points are particular to milled peat:

(*a*) The maximum angle of up-gradient with the plain belt has been limited to 20 deg. At angles in excess of this it is considered that the amount of lumps rolling back down the belt would cause excessive spillage. The critical angle is, of course, affected by the speed, belt width, and troughing angle. The belt speeds at Rhode are greater than at Ferbane or Bellacorick. The belt width and speed chosen are influenced by the space available without extra building costs, e.g., at Rhode the two belts, each 36 in wide, for the full 80 MW development of the station fit between No. 2 boiler and the temporary wall of the building. The belt speed was increased to allow of this.

(*b*) The belts run on troughing idlers, each set comprising three idlers with the two outer ones at 30 deg to the horizontal. In view of the light specific weight of the fuel carried, this angle is used to give a reasonable carrying capacity.

(*c*) Fig. 20 gives the capacity of belts carrying milled peat with a troughing angle of 30 deg.

(*d*) The chutes from one belt to the next are of very ample design to avoid hanging up and the minimum angle used is about 70 deg. The experience to date has shown these chutes to be satisfactory with the full range of fuel quality and moisture content.

*Power Station Design Engineers at the Electricity Supply Board of Ireland.

*Fig. 19. Main rising belts to boiler house—Ferbane Station*

(*e*) The belts are cleaned by hard rubber counter-weighted blades and these have succeeded in keeping the surface of the belt reasonably clean. There is some build-up of briquetted dust on the return idlers near the driving end but this has not been serious. At Ferbane plain surface steel driving drums with snubbing drums are used and no sliding has been observed. At Rhode the main rising belt has a fabric-covered driving drum.

(*f*) Rubber belts. So far no appreciable wear has been observed at Ferbane, except in one instance that could not be attributed to normal conditions. It is expected that the belt life should be very long, perhaps even the full life of the plant. Having the bottom cover the same as the top cover so that the belts could be turned after a certain number of years was considered. However, it was felt that even this would not have been justified since the fuel is light and non-abrasive.

**Belt Weighers**

Belt weighers are provided on all belt systems and are situated on the 20-deg slope. These weighers are exactly similar to those used in coal stations.

**Magnetic Extractors**

At Ferbane magnetic extractors on the belt systems were not initially installed. Small pieces of tramp iron, that is, bolts, nuts, and small pieces of shafting, were found in the mills. Some larger parts were also found in the fuel such as wagon coupling chains or even parts of buffer gear. It was decided, in view of the danger that these larger parts represented to the boiler mills, to install magnetic extractors. Two magnetic extractors have now been installed, one on each of the main rising belts. The type chosen is overhead self-cleaning type as seen in Fig. 21. Power consumption is 5 kW, plus a 5-h.p. motor driving the cleaning belt. The total weight of each extractor is 5 tons.

It has not yet been decided whether to install extractors in Rhode or Bellacorick, but because permanent couplings join the wagons in these stations, it is likely that they can be done without or a simpler type used which detects metals and trips the belt, and at the same time drops a marker to show the position of the foreign body. It can then be extracted by hand and the belt restarted.

**Shuttle Belts over Boiler House Bunkers**

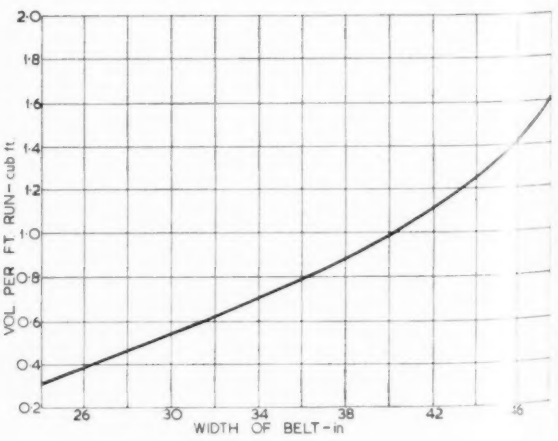
It can be seen from Fig. 18 that at Rhode (as also at Ferbane) two shuttle belts are provided over the boiler house bunkers, of which both the belt and carriage are reversible. With wet fuel, when all four mills are in operation the shuttle belt can shuttle automatically between pre-set limit points mounted on the track, thus achieving some blending of the fuel. The boilers are often run on less than four mills, and in this case the shuttle carriage is operated by hand, feeding in turn into the parts of the bunker requiring fuel. To allow of this, the belt and carriage drive controls are duplicated at the ends of the shuttle frame and are easily accessible to an operator on the walkway over the bunkers.

The top of the bunker below the shuttle belt is open; on each side of the belts and between them walkways are provided. The openings for the shuttle belts are protected by hand-railing as it was considered that all grades of milled peat would not flow satisfactorily, through even widely spaced grid-work. The dust rising from the transfer points or from the bunkers has proved to be a nuisance but is not serious except when loading very dry fuel. Various methods of completely covering the bunkers to prevent escape of the dust have been examined at Ferbane, including the use of air curtaining over the bunker openings. However, no satisfactory scheme has been evolved to date.

**Outdoor Storage**

At Ferbane one of the underground belts being fed from the tipplers is reversible. This belt, which normally feeds into the belt system going to the boiler bunkers, feeds, when reversed, to a tower in an outdoor storage yard. From this tower a cantilevered belt delivers the fuel to a point 30 ft above ground level. (See Fig. 1, Pt. 1.) The intention is that the fuel can be stocked out into the outdoor storage from this point. It is intended to store the fuel using special bulldozers to form a pile 20 to 25 ft high containing about 25,000 tons. It is estimated that this would cover about five acres. The bulldozers would spread the fuel from the delivery point and also compact it to avoid the danger of spontaneous combustion; they would also reclaim the peat into twin underground concrete bunkers, the fuel being taken from these bunkers by two steel cell conveyors similar to those under the tipplers and feeding on to a belt which feeds the fuel back to the belt system leading to the boiler house bunkers. The capacity of the handling system in and out of the storage can be seen in Table 3. This storage has not been used at Ferbane and so far the station has been run successfully without storage at the station other than the

*Fig. 20. Average carrying capacity belts for milled peat at 30 deg troughing at 450 ft/min*



boiler bunkers. Fig. 22 is a photograph of the stocking-out tower.

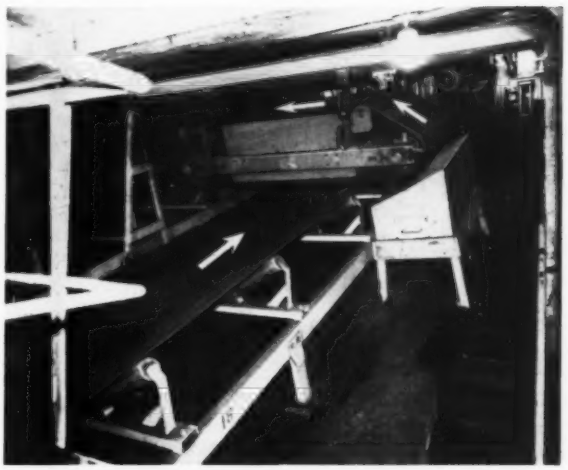
Outdoor storage is not being provided initially at either Rhode or Bellacorick.

**Boiler House Bunkers**

One bunker at Bellacorick is shown in Fig. 23, and can carry 340 tons (at 19 lb/cu. ft.). The Ferbane bunkers were designed structurally for fuel up to 35 lb/cu. ft., and subsequent stations to 28 lb/cu. ft., as later experience at Ferbane has shown this to be sufficient. There are four openings per bunker, to accommodate four feeders to the four mills associated with corner firing on each boiler, and each opening is dimensioned approximately 20 ft long, 4 ft in wide. The angle of the back and front faces of the bunkers is vertical and the side angles are as shown in the drawing. It was found best to keep the side angles about 70 deg. It is also better to have one steeper than the other. The bunkers are lined with mild steel plate without any special treatment. The bunkers in all stations are to E.S.B. specifications as far as slopes and openings are concerned and are based on tests carried out on a pilot timber bunker constructed for this purpose some years ago. This bunker had sides which could be changed in angle and an adjustable opening in the bottom. These tests showed that the angles of bunker slopes should be kept between 70 deg and vertical and that two sloped sides should not come together; thus a long opening was necessary, the opening being the full width of the bunker. They also showed that the minimum required opening was 4 ft 6 in.

The experience so far has been that there are no arching difficulties as long as the fuel is kept moving. If the fuel lies in the bunker for any length of time (two or three weeks), there is difficulty in extracting it. However, no serious problem has arisen on this score. One of the bunkers at Ferbane is provided with air lancing points; these are supplied from compressed air containers at a pressure of 75 to 90 lb/sq. in., connected by large-bore piping of small pressure drop. These were not found to be very satisfactory, since they only blew small holes in the fuel without disturbing the arches. However, a portable air probe from the same air supply has been used with some success to knock down the vertical wall of fuel that occurs when emptying a bunker that has been standing for a long period.

22

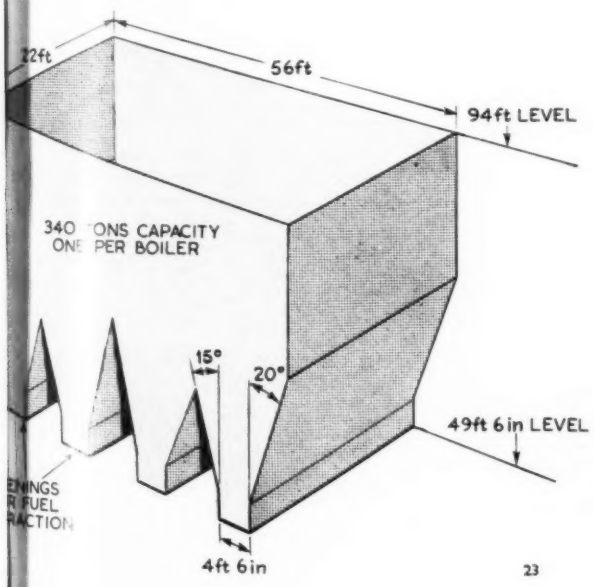


21

*Fig. 21. Magnetic extractor at Ferbane Power Station*

*Fig. 22. Stocking-out tower for outdoor storage at Ferbane Power Station*

*Fig. 23. Boiler house bunker at Bellacorick Power Station*




23

The capacity of the bunkers is such that the station can remain on full load overnight when supplemented from wagons in the marshalling yard or on the rails before the tipplers.

Two of the three bunkers at Ferbane were fitted with curved plates in the corners and the third was left with its corners squared. The experience to date indicates that the curved plates are not essential but that they make it easier to clear the bunkers of fuel and lessen the danger of arching.

**Extraction of Fuel out of Boiler House Bunkers**

Four extractors are provided per boiler at all stations; each feeds a mill (Fig. 18). The extractors used at Ferbane, Rhode 1 and 2 and Bellacorick are scraper-type conveyors consisting of traverse pieces moving along the length of a stationary mild steel plate that forms the bottom of the bunkers under the openings shown in Fig. 23. The scraper

**Table 1 Programme for Electrical Generation from Milled Peat**

| Name of Station | Location | initial Capacity | Possible Final Development | Estimated Consumption initial | Estimated Consumption Final | Remarks |
|---|---|---|---|---|---|---|
| Ferbane | Co. Offaly | 60 MW (3 × 20 MW) | 90 MW (+ 1 × 30 MW) | 500,000 ton/annum | 900,000 ton/annum | 60 MW commissioned 1957/1958 30 MW due 19[illegible] |
| Rhode | Co. Offaly | 40 MW (2 × 20 MW) | 80 MW (+ 1 × 40 MW) | 350,000 | 703,000 | 40 MW to be commissioned 19[illegible] + 40 MW due 19[illegible]3 |
| Bellacorick | Co. Mayo | 40 MW (2 × 20 MW) | 60 MW (+ 1 × 20 MW) | 320,000 | 480,000 | 40 MW to be commissioned 1962-6[illegible] |
| Shannonbridge | Co. Offaly | 40 MW (1 × 40 MW) | Not yet certain | | | 40 MW due 196[illegible] |

conveyor is shown on Fig. 24. The traverse pieces are attached to two chains, one on each side of the feeder table. The scraper speed is remotely controlled by means of variable speed hydraulic drive and the speed can be controlled from 2 ft to 11 ft 10 in/min. The peat is first taken to the back end of the conveyor where it drops through on to the lower table, it is thence conveyed forward to the front end over the mills from where it drops down the fuel chute to the mills. The quantity of fuel delivered to the mills is controlled by the scraper speed. The height of the fuel bed taken by the scraper can also be controlled by means of a guillotine door, the maximum height of fuel bed being 1 ft 10 in. However, this is only used initially to achieve a suitable range of scraper speed. Each conveyor is fitted with a 16 h.p. motor.

Trouble was experienced with the Ferbane conveyors due to the chain links becoming over-stressed. At first it was thought that the over-stressing and subsequent elongation of the links was due to the fibrous nature of the material handled, adding to the pressure exerted by the fuel in the bunker. However, tests showed that it was the static tension, and not the dynamic load that comes on the chain when the scraper moves through the fuel, that was causing the damage. The excessive static tension was due to having the drive at the end opposite to the extraction side as shown on Fig. 24, and also having a type of drive that could be over-ridden, so that it was necessary to use excessive tension to prevent the chain slipping on the hexagonal driving head. The teeth on the hexagonal driving wheel were intended as guides to keep the chain central and were not designed to give a positive pull to the chain. These conveyor drives are now changed to the extraction side of the bunkers. This has lessened the tension necessary on the chain in order to get satisfactory non-slipping of the drive. Trouble has been experienced due to wear on the side plates.

**Table 2**

The following table gives approximate data for bulk density and sizing of the fuel:—

| | Quality | | |
|---|---|---|---|
| | Poor | Average | Excellent |
| Bulk density at average moisture content of 55 per cent—lb/cu. ft. | 13 | 19 | 25 |
| *Screening Analysis* | | | |
| Retained on $\frac{1}{4}$ in | 15 | 15 | 12 |
| Passing $\frac{1}{4}$ in, retained on $\frac{1}{8}$ in | 21 | 26 | 27 |
| Passing $\frac{1}{8}$ in, retained on $\frac{1}{16}$ in | 11 | 11 | 10 |
| Passing $\frac{1}{16}$ in, retained on $\frac{1}{32}$ in | 13 | 14 | 14 |
| Passing $\frac{1}{32}$ in, retained on $\frac{1}{64}$ in | 15 | 11 | 10 |
| Passing $\frac{1}{64}$ in | 25 | 23 | 27 |
| | 100 | 100 | 100 |

At Rhode, the tables on which the conveyors run are covered with 25 mm of basalt brick attached by 10 mm thickness of cement; the side plates of the conveyor casings are also covered similarly. This will give prolonged life of the tables and side walls, particularly of the bottom side walls where the chain is slack and rubs against the plates. Fig. 25 shows the extent of this lining.

Plate conveyors instead of scraper conveyors will be employed at Rhode No. 3. The essential difference between scraper and plate conveyors is that in the latter the moving

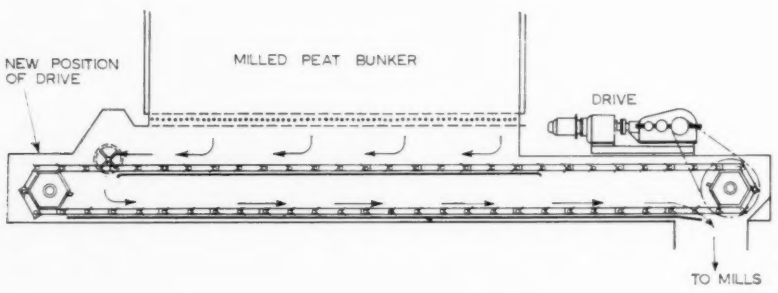



*Fig. 24. Scraper conveyor for extraction of fuel from boiler house bunkers Ferbane Power Station*

**Table 3 Details of Plant**

| | | Ferbane | Rhode | Bellacorick |
|---|---|---|---|---|
| Tipplers | Number of tipplers | 2 | 2 | 1 |
| | Rating per tippler, wagons/hr | 50 | 40 | 50 |
| | Type of tippler clamping | Hydraulic | None | None |
| | Electrical supply to tippler drum by | Trailing cable | None | None |
| | Method of driving tippler drum | Friction drive at four points | Friction drive at four points | Gear drive at one end |
| | Diameter of tippler drum | 13 ft 9 in at rim | 16 ft 1 in | — |
| | Turning motion | 360 deg alternatively left and right | 360 deg alternatively left and right | 360 deg alternatively left and right |
| | Drive motor | Two speed { H.S. 15·5 kW L.S. 2·0 kW | Two Speed { 15·5 kW 1·7 kW | Two speed 20 kW |
| | Turning speed | Slow speed 20 deg in 6·8 sec<br>Fast speed 20 deg in 11·74 sec<br>Slow speed 320 deg in 6·8 sec<br>Total: 28·5 sec<br>Angle adjustable | 25 to 33 sec adjustable | 15·5 deg per sec |
| Conveyors plate | Number per tippler | 2 | 2 | 2 |
| | Capacity cu. ft/hr each | 15,000 | 12,000 | 15,000 |
| | Speed inches per sec | 10 in | 10 in | 12 in |
| | Width | 48 in | 54 in | 48 in |
| | Angle of rise | 25 deg | 30 deg | — |
| Belt Systems | No. of belt systems to boiler house | 2 | 2 | 1 |
| | Capacity | 30,000 cu. ft/hr | 23,700 cu. ft/hr | 30,000 cu. ft/hr |
| | No. of Belt systems to and from stocking-out area | 1 | None | None |
| | Capacity | 15,000 cu. ft/hr | — | — |
| Belts | Width | 47¼ in | 36 in | 42 in |
| | Speed ft/min | 410 | 495 | 420 |
| | Angle of rise | 20 deg | 20 deg | 20 deg |
| | Angle of trough | 30 deg | 30 deg | 30 deg |
| | Plys of main belt | 5 | 5 | 5 |
| | Class of belting | Grade A 32-oz duck | Grade B 36 oz | Grade A 48-oz duck |
| | Top cover | 2 mm | ⅛ in | $\frac{3}{32}$ in |
| | Bottom cover | 1 mm | $\frac{1}{16}$ in | $\frac{1}{16}$ in |
| Shuttle Belt | Width | 47¼ in | 40 in | — |
| | Speed ft/min | 540 | 495 | — |
| | Carriage speed ft/min | 30 | 30 | — |

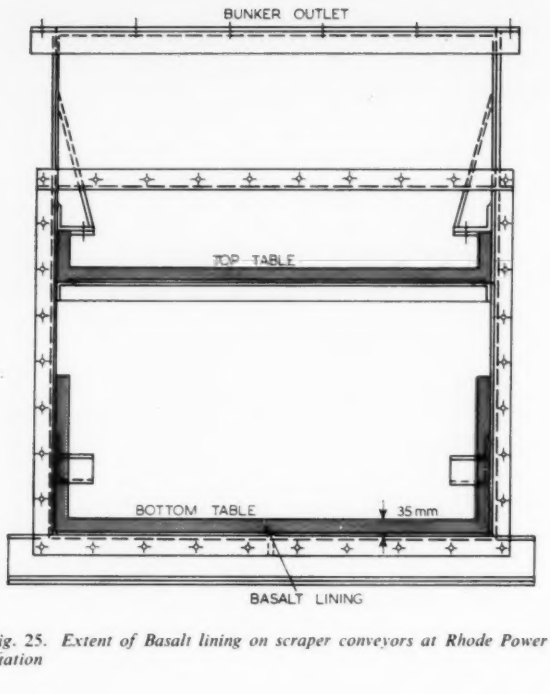



*Fig. 25. Extent of Basalt lining on scraper conveyors at Rhode Power Station*

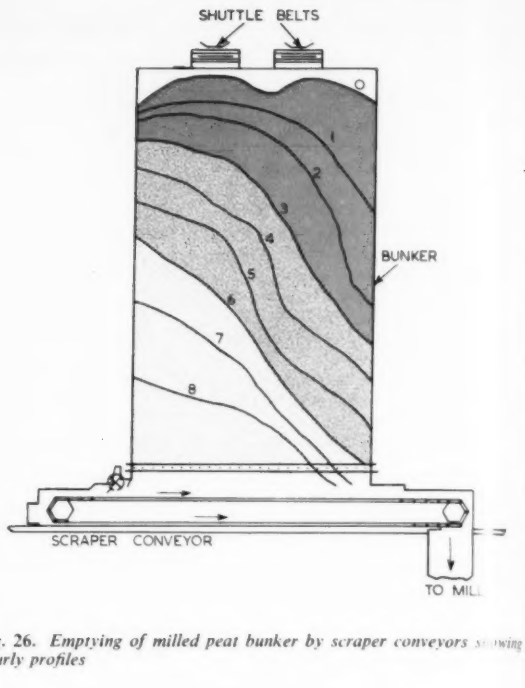



*Fig. 26. Emptying of milled peat bunker by scraper conveyors showing hourly profiles*

plates themselves form the supporting table under the bunker opening, while the scrapers operate across a stationary table. The plate conveyor takes the peat forward directly to the mills unlike the scraper conveyor described above.

An auxiliary cleaner conveyor is employed under the plate conveyor to collect the small amount of peat which is carried around in the joints of the steel cells; this auxiliary conveyor is operated once per shift.

Plate conveyors and scraper conveyors cost roughly the same from one supplier but are widely different in cost from a second. The power consumption of the steel cells is lower than for a scraper conveyors.

The bunker emptying at Ferbane has not been 100 per cent satisfactory, the fuel tending to funnel down the front of the bunkers as shown on Fig. 26. This funnelling has the disadvantage that a dead section of peat is left permanently on the other side of the bunker unless the bunker is completely emptied; this dead portion will tend to harden and will form arches; in an effort to prevent this, several constructions, such as channels placed at different levels above the scraper conveyors, were tried. However, these have not been very satisfactory and they increase the danger of arching. Two other methods have been suggested:—

1. That the opening over the conveyor be narrowed back from the delivery end of the conveyors, in a similar manner to that adopted with the hoppers under the tippler. This has been tried with one conveyor at Ferbane without too much success. The relation between length and breadth of opening makes such tapering ineffective due to arching where it operates satisfactorily on the small tippler hoppers, see Fig. 17, Pt. 1.

2. Splitting the table under the scraper so as to have two openings, one at the delivery end and one in the centre. It is intended to try this at Ferbane.

These suggestions also have the disadvantage that they tend to obstruct the opening in the bunker and hence make arching more likely.

**Blending Bunker**

A blending bunker in the fuel handling system, as depicted in Fig. 4, would smooth the variations in moisture content of the fuel over a period of several hours, depending on its capacity. The bunker would consist of an enclosed storage into which the fuel would be loaded by means of shuttle belts. The fuel would then be extracted using a special device operating to extract the fuel by means of worms and scraper chains across the complete face of the storage space; as the fuel is put in in horizontal layers and taken out in vertical strips, the fuel sent from the bunker to the boiler house is an even mix of the contents. It should be noted that the blending bunker would also serve the purpose of storage and with its use the boiler bunkers could be reduced in size.

From the costs arising, it is considered that an increase in boiler operating efficiency of 2 per cent over the year would have to result in order to justify its inclusion. It is not clear that such an improvement in operating efficiency would be forthcoming from the installation of this equipment. From experience to date, which experience included the period of 'teething' troubles and the development of firing techniques on the boilers using this unfamiliar fuel, the availability and operating efficiency of the boilers is such that expenditure on a blending bunker has not been undertaken.

The moisture content of the fuel arriving at the station varies from 40 per cent to 65 per cent. Successful techniques for burning milled peat without furnace instability or excessive slagging have to date been evolved for peat between 45 per cent mc and 62 per cent mc; development is continuing. In practice to date the peat delivered to the station does not vary radically from one train load to the next, and no particular difficulty is encountered in efficiently operating the boilers between the above limits. It should be noted that 62 per cent mc peat has just twice the water content of 45 per cent peat and this range is very wide.

**Sampling Device**

Sampling in order to arrive at a figure for the average moisture content and for the average calorific value of the

fuel delivered to the power stations is necessary for two reasons: (*a*) in order to estimate the performance of the plant (*b*) to keep the accounts straight between the fuel supplier, Bord na Mona, and the Electricity Supply Board since the price of fuel delivered is based on a sliding formula for moisture content.

Some tests have been carried out to find out if the moisture content of the fuel could be ascertained by some continuous method, such as the measurement of the dielectric constant or the resistance of the fuel. A satisfactory solution along these lines has not yet been found, due to the varying density of the peat but experiments are continuing. Samples from the fuel are taken as delivered to the station, mixed and divided down to laboratory size for testing. As explained above, milled peat must be considered as a variable fuel, i.e., not only variable in moisture content and quality but also in particle size, consisting of lumps, dust and fibres—all of which contain different percentages of moisture and tend to segregate when the fuel is handled.

To get an accurate figure, constant sampling must be carried out and the samples, if taken from a moving conveyor, must be across the complete cross-section of the conveyor and must be fairly large compared with sampling of other fuels. The Ferbane sampler takes approximately one sample per minute from conveyors and with the full belt cross-section this means 10 to 15 lb of fuel per sample. This gives a total sample of 0·05 per cent to 0·1 per cent of the fuel carried by the conveyor.

Hence it can be seen that for 1,000 tons delivered to the station a sample will consist of ½ to 1 ton. This would raise a considerable problem in labour if treated manually to reduce it to laboratory size.

Two automatic sampling devices have been installed at Ferbane, one on each of the drive heads of the main rising belts. These sampling devices consist of a flap situated at the back of the transfer chute where each belt feeds on to the belts running across the boiler house. The flap opens out into the falling fuel as it comes off the belt. The flap extends the full width of the belt. It is opened by means of a ratchet driven by chain and gear from the belt drives. The ratchet is fitted with a pawl that engages the flap every so often at a rate depending on the gear train. The flap is closed by spring. The sample thus collected is dropped on to a worm conveyor and is fed across to the top of a chute leading down the tower. This chute is split by flaps at four points on the way down. The flaps being adjustable. Fig. 27 shows the riffler chutes coming down the tower and the bucket conveyor taking the rejected part of the sample back to the belts. The flaps are adjusted in such a way that the sample is riffled on the way down and only a percentage

**Table 4**

**Total Cost of Fuel Handling Plant in Milled Peat Stations**

It is difficult to give accurate figures for this, since some of the plant structures, foundations, etc., which is properly considered as fuel handling, services other functions. For example, the bunker structure forms an integral part of the building. However, the following are approximate costs worked out on an installed KW basis.

| | Cost of Fuel Handling Plant per Final KW installed Capacity |
|---|---|
| Civil Works associated with fuel handling plant | £0·33 to £0·38 |
| Railways on station site | £0·08 to £0·09 |
| Bunker and other steel structures | £1·38 to £1·50 |
| Buildings and cladding, etc. | £0·22 to £0·26 |
| Mechanical and electrical plant, conveying fuel to bunker top | £0·82 to £0·87 |
| Mill feeders | £0·78 to £1·02 |
| Total: | £3·61 to £4·12 |

These figures include all overheads

**Table 5 SUPPLIERS OF PLANT**

| | Ferbane | Rhode (First Development) | Bellacorick |
|---|---|---|---|
| Main mechanical plant (Main contractor) | Hartmann Offenbach | Hartmann Offenbach | Pohlig Köln |
| Structural steelwork | Knauer | J. & C. McGloughlin | — |
| Cladding on bridges, etc. | J. & C. McGloughlin | J. & C. McGloughlin | — |
| Magnetic extractor | Steinert Electromagnetbau | — | — |
| Belt weigher | Schenck | Schmitt | Schmitt |
| Belting | Dunlop | Goodyear | — |
| Electric control gear | Klockner & Moeller | Klockner & Moeller | S.S.W. |
| Electric motors | B.B.C. & Demag | S.S.W. & Demag | S.S.W. |
| Civil engineering | Sisk | Irish Eng. & Harbour Constr. Co. | I. E. & H. C. Co. |
| Erection | Hartmann | E.S.B. | E.S.B. |
| Scraper conveyors in boiler house | Deutsche Babcock | Deutsche Babcock | Babcock & Wilcox, London |
| Main boiler house bunkers | J. & C. McGloughlin | J. & C. McGloughlin | J. & C. McGloughlin |

*Fig. 27. Riffler chutes at Ferbane Power Station, for sample reduction: (A) Division flaps. (B) Bucket conveyor for returning rejected part of sample*

of the actual sample taken is fed into a bin situated in a small sampler house at the base of the tower. The remainder of the sample is fed on to a small bucket conveyor which feeds it back on to the belt.

Both hand sampling and the samples taken from the automatic sampler were assessed against very extensive sampling from the wagons and it was found that the automatic sampling has less bias than the hand.

From this it can be seen that taking the sample by means of a flap situated along the back wall of the delivery chute at the drive end of a belt is suitable, though it should be noted that the flap has to be situated in such a position that the fine and larger pieces coming over the belt are intermixed. The percentage moisture content of the lumps may differ appreciably from that of the fines and the correct relationship must be maintained.

The gravity riffler system at Ferbane has not yet been successfully developed; it is found that the flaps used can only be positioned to halve the sample and thus three flaps give a reduction of one-eighth and four a reduction of one-sixteenth. Also, of the four flaps installed at Ferbane the first one was found to be incorrectly positioned relative to the fuel coming from the worm conveyor and was inoperative. This left only three with a total reduction of one-eighth, which is not sufficient. A reduction of 1/200 is the aim.

Development of samplers for the other stations is progressing. It is hoped completely to mechanize the taking, reducing and preparing of the sample; the final product being suitable for use in the laboratory for M.C. and C.V. evaluation. Experience with the sampling at Ferbane will determine the size and frequency of primary sample and the type of riffling desirable for other stations.

**Staff and Operation**

Operation of the fuel handling plant described above requires one tippler operator and one attendant at bunker top level. At Ferbane an extra man is required for recoupling wagons during periods of continuous loading. The normal functions of cleaning and running maintenance, such as greasing, is carried out by the station day staff.

The main control board for the Ferbane plant is shown in Fig. 28; it is situated in the top floor of a building near the tipplers; this building also houses the transformers and all electrical gear for the plant. A mimic diagram of the belt systems is included on the panel and it is from here that any plant required is started, except the shuttle belts that are controlled from over the bunkers. The control room is not normally manned unless an alarm warns the tippler operator that something has tripped. The marshalling and tippling cycle is fully automatic but if the operator desires, he can take over manual control from a control point beside each tippler.

At Rhode a control kiosk is provided between the tipplers from where the marshalling and tippling cycle, the steel plate conveyors and all belts are controlled.

The belts and plate conveyors are electrically interlocked at all the stations to prevent a pile-up of fuel in the event of any one belt tripping. A safety device is also provided on the Rhode main belts that trips the feed to these belts if their speed is not normal.

### Dust and Fire Hazard

The amount of dust during tippling and at the transfer points from one belt to another depends very much on the type of fuel being handled. When handling dry fuel (around or under 50 per cent moisture content), the tippler and transfer points are covered by air-borne dust. However, this dust has so far only proved of nuisance value. It has been found that when the dust settles out on plant and other ledges it dries and requires constant removal. Spontaneous combustion of peat is not a problem at the stations where peat is not stored for any length of time. At Ferbane an automatic sprinkler system for fire protection (seen in Fig. 19) has been installed along all belt bridges and over the tipplers. The belts running across the boiler house in all the stations have been completely enclosed to prevent dust falling down into the boiler house and the bunker bay has been completely isolated from the boiler house. This sealing off of the fuel handling bridge from the boiler house also prevents ingress of cold air if the combustion air for the boilers is taken from the top of the boiler house. A stationary vacuum cleaning plant is installed at Ferbane and is under consideration in the other stations. This will have suction points along the fuel handling plant adjacent to, or near the boiler house.

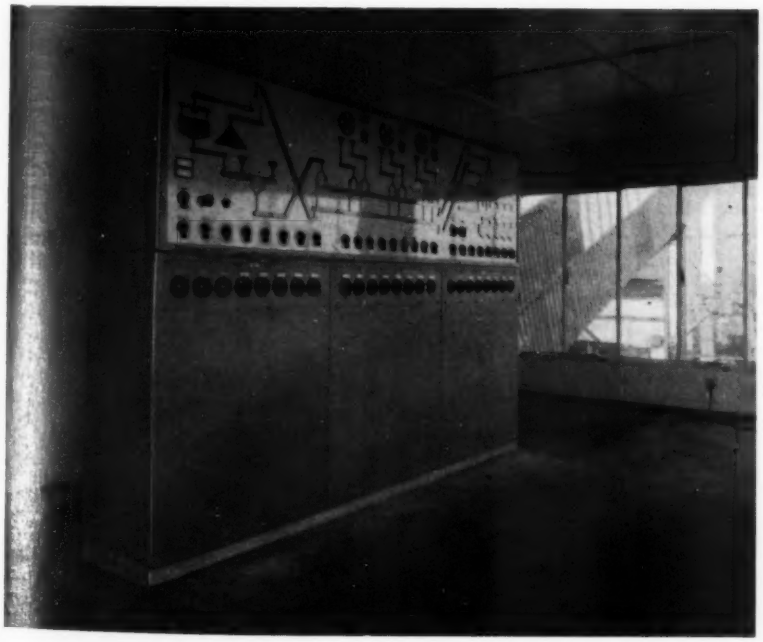
### Safety Precautions

At all stations trip wires are being installed along the belts; these trip wires can be seen on the main rising belts at Ferbane in Fig. 19; by knocking these wires the belt system is stopped. All drive heads are enclosed and cleaning from beneath them is by special tools inserted through openings situated so that the tool cannot come in contact with the moving parts.

A hooter is sounded before the plant is restarted and the sequence of belts is interlocked so that peat cannot pile up at any change-over point. No smoking is allowed at any of this plant.

The usual standards of safety which apply to the manufacture and operation of conveyor plants have been enforced in full.

*Fig. 28. Control panel for Ferbane fuel handling plant*



### Details of Fuel

Milled peat is taken off the bog by high-speed toothed drum type machines which remove about $\frac{1}{2}$ in depth at each operation. When milled, it contains about 88 per cent moisture and it is allowed to dry on the bog until the moisture content reaches 55 per cent on the average. It is then harvested into long storage piles on the bog.

Milled peat is a low-grade fuel consisting of decayed and semi-decayed vegetation. Its sizing varies from fine powdery dust to pieces of roots and root masses with small pieces of timber (see Table 2).

The peat varies considerably in quality and moisture content. There is no scientific definition of quality but the terms poor, average, and excellent, are usually employed to describe the different grades. The poorer the quality the more light fibrous matter in the peat and the lower the bulk density. The excellent quality contains a higher proportion of compact particles and it is darker in appearance and has a relatively high bulk density.

The moisture content may vary between 40 and 65 per cent irrespective of quality. Moisture of from 35 per cent to 70 per cent has been recorded for short periods.

The angle of repose of milled peat is about 40 to 45 deg with the horizontal; however, after some time consolidating in storage pile or bunker it is possible to carve a sheer face or even undercut when removing the fuel.

The proximate analysis of the fuel is:—

| | |
|---|---|
| Moisture content | 55·0 per cent |
| Ash ..... | 1·5 per cent |
| Volatile ..... | 30·3 per cent |
| Fixed Carbon ... | 13·2 per cent |

The gross C.V. of 1 lb dry turf can be taken as 9,300 B.T.U.s.

The net C.V. of 1 lb at 55 per cent M.C. can be taken as 3,375 B.T.U.s.

The variation of moisture content around the average for any particular quantity of milled peat depends on the increments taken. The main causes of variation can be listed under the following headings:—(*a*) Seasonal, caused by weather conditions during and after harvesting; (*b*) Locational, caused by varying conditions on different parts of the bog; (*c*) Positional, caused by varying exposure to the weather of different parts of storage piles, wagons, etc.; (*d*) Particle, caused by different drying rates of particles of different size.

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### Acknowledgment

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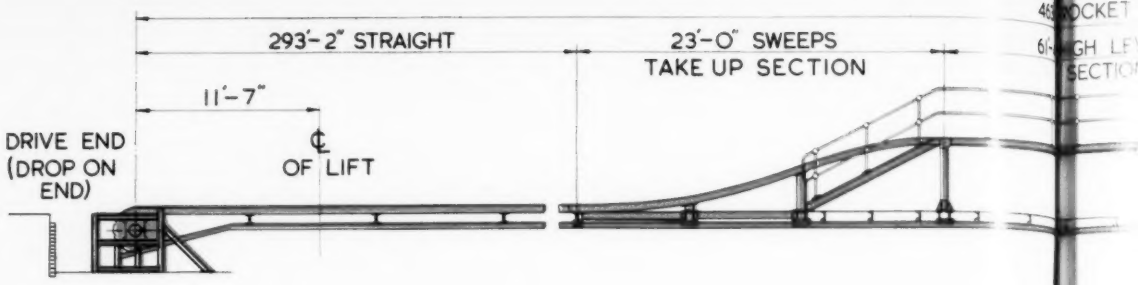



# BODY TRIM TRACKS AT LONGBRIDGE

By A. G. DOUGLAS CLEASE, B.Sc., A.M.I.Mech.E.

THE Longbridge, Birmingham, factory of the Austin Motor Co., Ltd., is well known for the very modern and highly mechanized equipment installed in it for the economical production of motor cars in vast numbers. It has many miles of conveyors of various types and amongst these are five body trim tracks designed, manufactured and installed by Weldall & Assembly, Ltd., Stourbridge, in the car assembly building which was extended in 1959 as part of the B.M.C. expansion scheme.

The complete installation of these five tracks covers a floor space of nearly 50,000 sq. ft., and each of the tracks is 463 ft 9 in long between the headshafts of the driving and tensioning ends. Each track has a high level section 61 ft 4 in in length, connected by ramps to the floor level and supported on fabricated steel pillars, as shown in the side elevation and plan, Fig. 1. The decking of the high level section is in some instances extended across between adjacent tracks to form a continuous elevated floor level, so that work on the bodies can proceed unhindered at the high level as well as at floor level beneath them.

Each track consists of twin slatted conveyors with their centres spaced approximately 4 ft apart, and having common drive and tensioning mechanisms, ensuring that they run at the same speed. On these the bodies are supported on jig posts attached to the top face of the slats. Provision is made in these jig posts for the variation in longitudinal distances which occurs as the bodies travel up or down the ramps.

Each of the twin conveyors consists of two strands of 8-in pitch Renold's roller chain of 24,000 lb breaking load, so that there are four strands of chain to each track. The length of each chain is 1,403 pitches or 935 ft 4 in, and the total length of chain for the five tracks is, therefore, nearly 20,000 ft or approximately 3¾ miles.

The two strands of chain of a conveyor are connected by spindles passing through the hollow bushes of each link of each strand, the centre portion of the spindle acting as a distance piece between the strands. The ends of the spindles form plain bearings for the cast iron rollers, which carry the conveyor in rolled channel section rails, and have grooves machined to receive Seeger circlips.

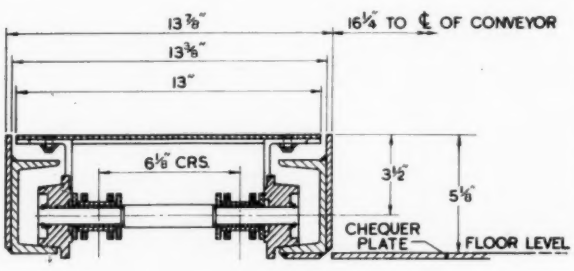
The rollers are not cylindrical but have a 5 deg coned face, which contributes to smoothness of operation. These details are shown in Fig. 2, which also shows the angle sections welded to the outer links of each chain to receive the slats attached to them by countersunk screws.

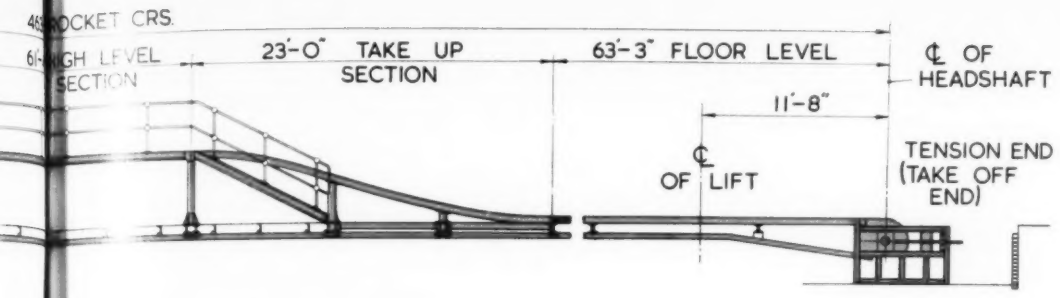
From the section through the high level structure, Fig. 3, the general arrangement of the track and some idea of the main features of construction can be gathered. The track is constructed above a pit 2 ft 9 in deep and 8 ft wide, over which are cross-bearers of rolled steel channel placed back to back with their ends anchored in the pit wall. These cross-bearers carry both the upper and return runs of the conveyor rails, the lower rails being attached by angle cleats. Details are shown in Fig. 4.

Bodies are loaded at the drive end and unloaded at the tension end by fully automatic electric lifts situated between the twin-slatted conveyors. Actually both ends are driven but provision is made for tensioning the chains at the unload end of the track.

The drive unit is housed completely below floor level in a pit and its base is a prefabricated frame of rolled steel channel secured to the concrete by foundation bolts. The longitudinal members of this frame are in pairs, and the cross-member at the end in the direction of travel carries angle pieces which form abutments for tensioning bolts for adjusting the location of the super-imposed sub-frame of

*Fig. 2. Sub-assembly of conveyor track. Note coned faces on rollers*






*Side elevation of a single body trim track*

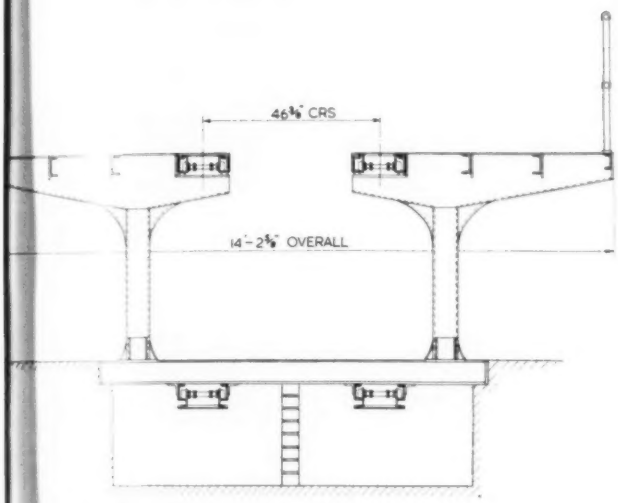
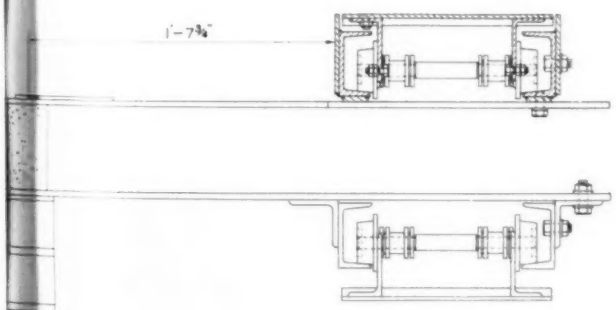



*Fig. 3 (above). Section through the high level section*




similar channel section on which are mounted the various units of the drive mechanism, Fig. 5.

These comprise a Crompton Parkinson squirrel cage 3-phase electric motor taking current at 400/440 V, 50 cycles, developing 5 b.h.p., connected through a flexible coupling to a Heenan & Froude Dynamatic slip coupling. These two units are mounted on a base plate secured by bolts to the main sub-frame, and having tensioning bolts to angle sections on the main sub-frame, Fig. 6.

On the output shaft of the Dynamatic coupling is a toothed sprocket from which a 0·5 in simple Renold's chain drives to a sprocket on the input shaft of a reduction gearbox having a reduction ratio of 157 to 1. This gearbox is designed and manufactured by Weldall in order to give the high reduction required without undue loss of efficiency often associated with worm reduction gearboxes. The output shaft of the gearbox carries a sprocket from which a 2-in duplex Renold's chain takes the drive to a sprocket on a layshaft carried in plummer blocks. The other end of the layshaft has a sprocket for a 2·5 in duplex chain which runs to a sprocket on the headshaft of the track. The headshaft has sprockets engaging with each of the twin conveyor chains; it is mounted in plummer blocks with Skefko spherical roller bearings.

The Weldall reduction gearbox is bolted to the main sub-frame, and the countershaft baseplate is mounted on another sub-frame which has tensioning bolts to angle abutments on the main sub-frame, so that adjustments for chain tension are provided for all three chain drives of the driving unit. The total reduction between driving motor and track headshaft is 1,200 to 1, and the speed of the track can be from 2 ft to 12 ft/min, depending on the production output required from the track, the normal speed being 2·70 ft/min.

At the tension end of the track there is a similar drive unit, but its headshaft is carried in sliding plummer blocks and can be moved longitudinally under the control of four long tensioning bolts passing to abutment brackets on vertical members of the frame structure.

At the drive or drop-on end the bodies arrive by overhead conveyor and from this they are received on the drop-on lift of screw jack type, which automatically lowers them into location on the jig posts on the twin conveyors. The lift has a central screw jack, driven by bevel gears, and

*Fig. [illegible] (above). Section through conveyor showing construction in pit*

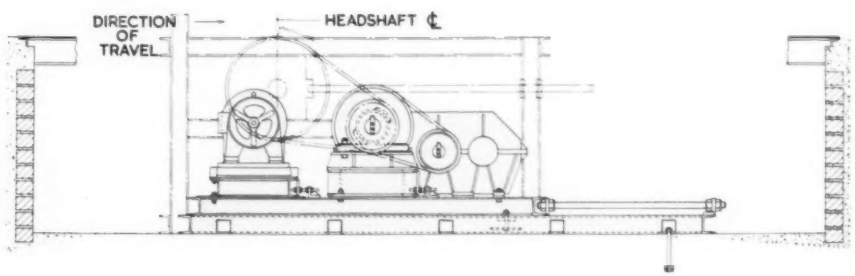



*Fig. [illegible] (right). Side elevation of drive unit, drive and tension end*

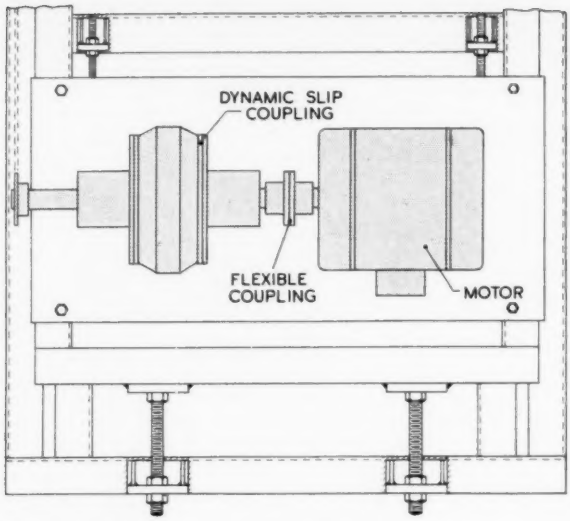



*Fig. 6. Layout of drive unit showing tensioning bolts*

two guide posts. Power is supplied by a Crompton Parkinson motor driving through a brake coupling to a reduction gearbox, the output shaft of which is coupled to the bevel pinion shaft of the screw jack. The brake is actuated by a solenoid. The general arrangements of this lift is shown in Fig. 7.

At the take-off end a similar lift unit is mounted on a base frame carried on four wheels running on rails, so that it can travel forward horizontally in the same direction as the track in order to avoid fouling the following body. The traversing mechanism, Fig. 8, consists of a Crompton Parkinson electric motor driving through a Stancroft brake coupling to an Oppenham gearbox giving a 60 to 1 reduction, thence by a 1-in chain down to a countershaft below the floor of the unit carried in Ransome & Marles plummer blocks. On one end of the countershaft is a pinion meshing with a stationary rack, forming the final drive of the traversing mechanism and eliminating slip.

As previously stated, the lifts are entirely automatic in action under the control of switches operated by suitable attachments to moving portions of the installation. Thus the operation cycle at the load end is as follows:—

1. A sling carrying a body moves into the drop section of the overhead conveyor which supplies the tracks. The drop section will not lower if the sling is not in position

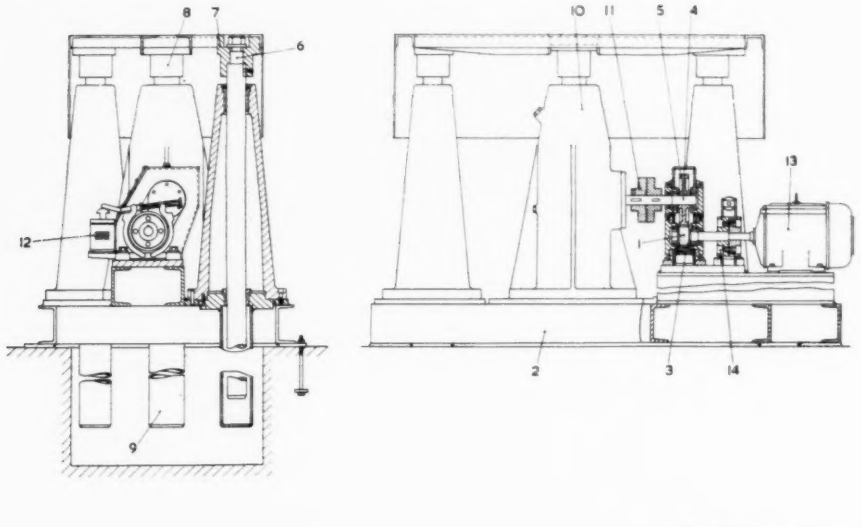
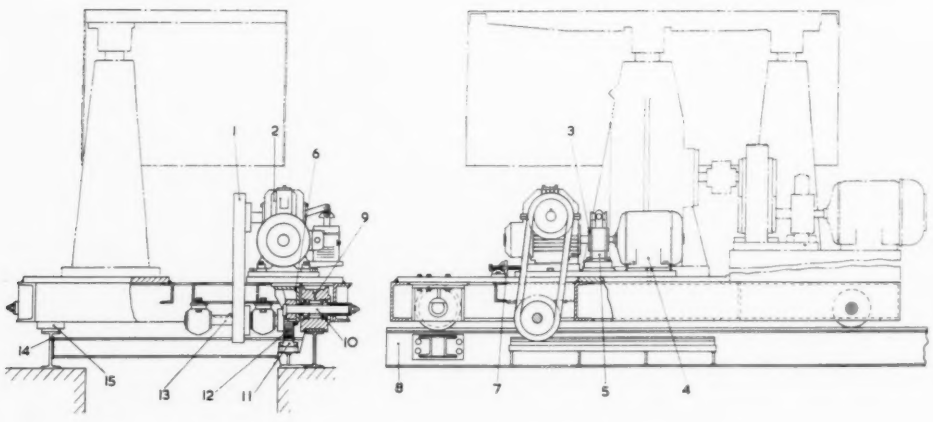



*Fig. 7. General arrangement of drop on lift*

KEY to Fig. 7.
1. drive pinion; 2. lift base; 3. gearbox case; 4. output shaft; 5. spur gear; 6. guide pillar; 7. platform; 8. centre bush; 9. screw jack cover; 10. ram body; 11. solid coupling; 12. solenoid brake; 13. 5-h.p. electric motor; 14. brake coupling

*Fig. 8. General arrangement of traversing-drive for take-off*




KEY to Fig. 8.
1. chain drive; 2. gearbox; 3. flexible brake coupling; 4. 5-h.p. electric motor; 5. solenoid brake; 6. traversing base; 7. tension bracket; 8. side rail; 9. flanged roller; 10. roller shaft; 11. rack; 12. drive pinion; 13. drive shaft; 14. slide rail; 15. plain roller

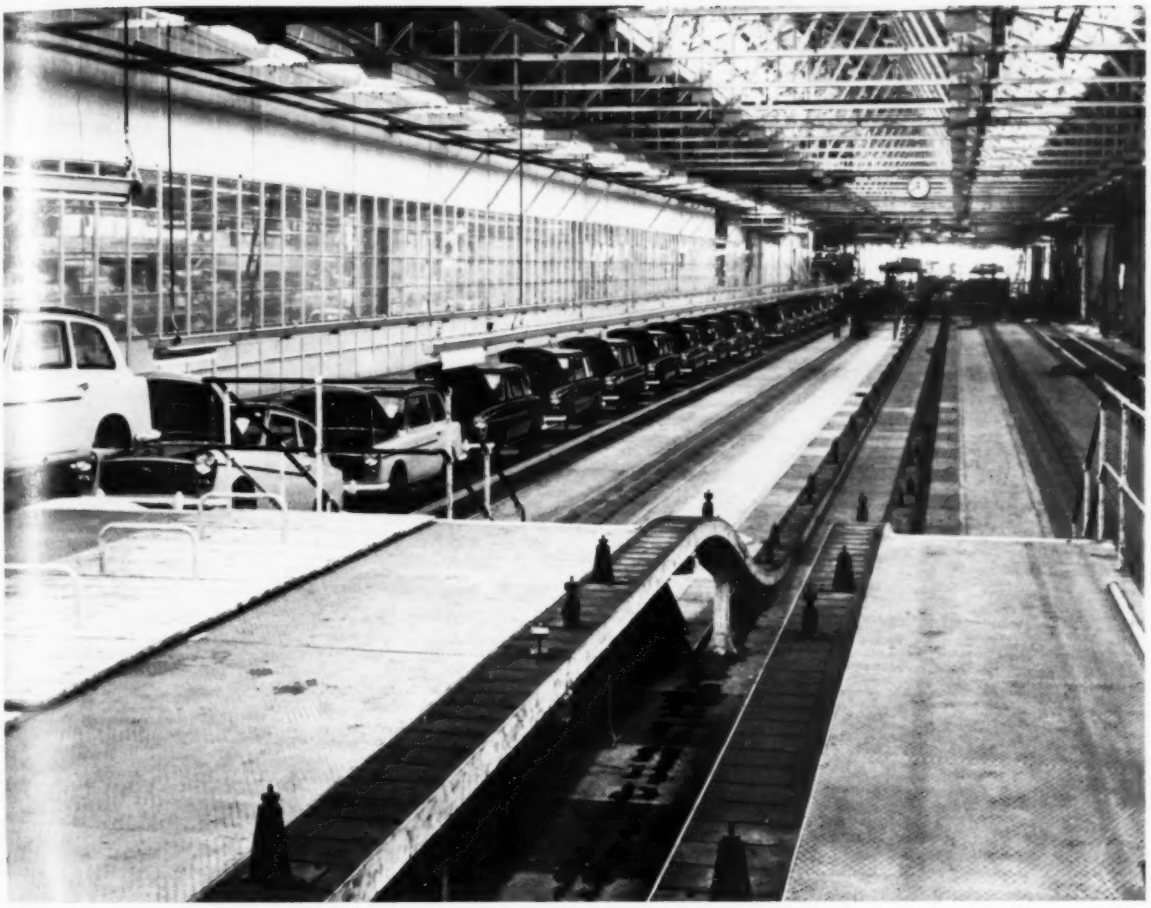
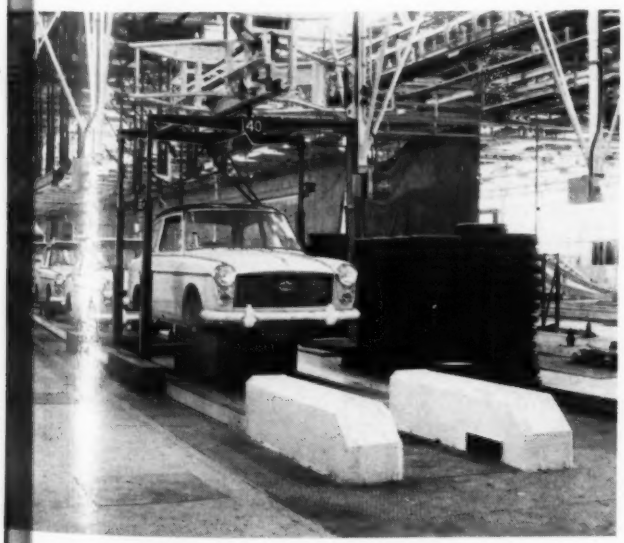


*Fig. 9. Looking towards the drop-on or loading end*

BELOW

*Fig. 10. The take-off lift has raised a body ready for the feet of the sling to be turned beneath it. The sling and drop section will then rise to transfer the body to the overhead conveyor which removes it*



2. The lift is called up by the rear jig post on the moving track actuating a switch.

3. Upward movement of the lift actuates a switch and calls the body in the drop section to the hover position.

4. The moving jig post actuates another switch, causing the body to be lowered from the hover position into location on the lift.

5. The sling continues downwards in order to clear the body.

6. The feet of the sling are turned out in order to clear the body, this being at present a manual operation.

7. The moving jig post actuates another switch, causing the sling and drop section to rise.

8. The rising drop section prepares a limit switch, interlocked with which is another switch operated by the moving jig post, and the lift begins to lower the body on to the jig posts.

9. The lift continues to its bottom position and the body proceeds with the track.

At the take-off end the sequence is as follows:—

1. A sling is called into the drop section of the overhead conveyor removing the bodies by a loaded sling moving out.

2. The drop section is called to its bottom position by the loaded body passing a limit switch.

3. A track limit switch operates the lift to raise the car from the track fixtures.

4. When the body is clear of the track fixtures a limit switch operates the forward traverse mechanism.

5. As the forward traverse takes place the lift continues to rise to its top position.

*Fig. 11. The bodies at the high level section. There is a continuous high level floor between adjacent tracks at this point. The jig posts on which the bodies are supported on the track are clearly seen*

6. The sling legs are turned in, by hand.
7. A track limit switch calls the lift down to lower the body into the sling.
8. Downward movement of the lift operates a switch to call the sling with the body, and the drop section, upwards.
9. As the lift reaches its bottom position it initiates the reverse traversing action.
10. If the lift fails to reach its backward position a safety limit switch closes the conveyor down before the following body reaches the pick-up position.

*Fig. 12. Three of the twin slatted conveyors, with their elevated sections in the background*

# MATERIALS HANDLING AND AUTOMATION IN THE FOUNDRY

by L. Landon Goodman, B.Sc.(Eng.), A.R.T.C.S., A.M.I.Mech.E., A.M.I.Prod.E., F.R.S.A.*

NOT SO LONG ago it could be said that for every ton of castings produced about 100 tons of materials had to be moved, usually man-handled, between stockyard and fettling shops. The distance moved by the operators would be close on seven miles. No doubt over the whole of the foundry industry great improvements have taken place in the last few years, yet in any industry where large amounts of materials have to be moved there is always scope for improvements both by revising old methods and by introducing regularly the fruits of technology.

The figure for the ratio of the comparative costs of a human horse-power hour and an electrical horse-power hour is between 300 to 400 to 1 and, indeed, provides a signpost to cost reduction and increased productivity. But electricity is not only a large and most economic 'multiplier' of man's physical power, it is also an even greater multiplier of man's mental power. Automatic control equipment can now operate plant of a complexity which is beyond human ability and computers can already perform computations in a matter of minutes that would take a team of mathematicians weeks to complete.

The trend in costs of different types of energy is illuminating. From 1924 to 1956 the number of industrial kilowatt hours purchasable at the cost of an average industrial man-hour increased from 11·2 to 40·6, in 1938 it was exactly half, namely, 20·3. These figures being obtained by dividing the average hourly earnings of production workers in the manufacturing industries in a given year by the average cost of the kilowatt hours sold to industry for that particular year. In the U.S.A. this figure has risen from 39·1 in 1924 to 220 in 1956. It is of interest to note that the United States' figure is four to five times the corresponding figure, and also that the electrical horse-power at the worker's elbow in the U.S.A. is about four times that at the British worker's elbow.

**Foundry Layout**

The proper application of the principles of plant layout can give any desired degree of flexibility. Planning 'tools' include three-dimensional models, template layouts, string-in, isometric drawings, flow diagrams and work-measurement diagrams. A foundry layout should be carefully planned before mechanical aids are introduced—this invites continuous research into production methods. Site conditions often restrict the layout; it is, however, advantageous to keep in mind the ideal layout if no such limitations existed. As stressed below, materials handling is a 'necessary evil' and a first endeavour is to eliminate the handling whenever possible. One way is by a suitable plant layout. In a foundry several materials flow in a circle, e.g., moulding sand and mould boxes, which suggests that the knock-out section could well be alongside or close to the moulding department reducing the lengths of conveyors, etc. Again, it is desirable that raw material storage should be within the plant proper in a roofed-over yard or actually within the building so that the costs of double transfers are eliminated and the raw materials are adjacent to the melting operation.

Thus, an ideal scheme should be finalized and the layout brought as close as possible to that ideal, bearing in mind practicalities and costs. Similarly, the planning of an automatic foundry is surely not a waste of time. The full plan might be, no doubt would be, economically impracticable at present, but various facets of it might be found to be immediately applicable to the existing or to a modified method of working. This approach facilitates the introduction of new techniques such as electronic inspection and control equipment which probably would form an essential part of an automatic foundry.

A decision about the required degree of flexibility must be made at an early stage. Flexibility is costly and should not be called for unduly. Too often, however, in many industries flexibility is pleaded as an excuse for little or no planning. Good planning based upon sound management judgment, together with an element of intuition, can clearly demonstrate savings resulting over a given period of time from a layout and plant designed with a particular purpose in mind.

**Materials Processing**

This is a technology covering those operations through which material passes during the course of manufacture—operations which change its form or composition or indicate its quantity or quality. Examples are melting, pouring or sprue removal.

**Materials Handling**

Materials handling is the technology which covers the handling and storage of material. The object of a materials-handling study is to eliminate handling as far as possible and to assess if the remainder can be economically and practically mechanized.

* Industrial Specialist, British Electrical Development Association. Based on a paper presented to the Sheffield Branch of the Institute of British Foundrymen.

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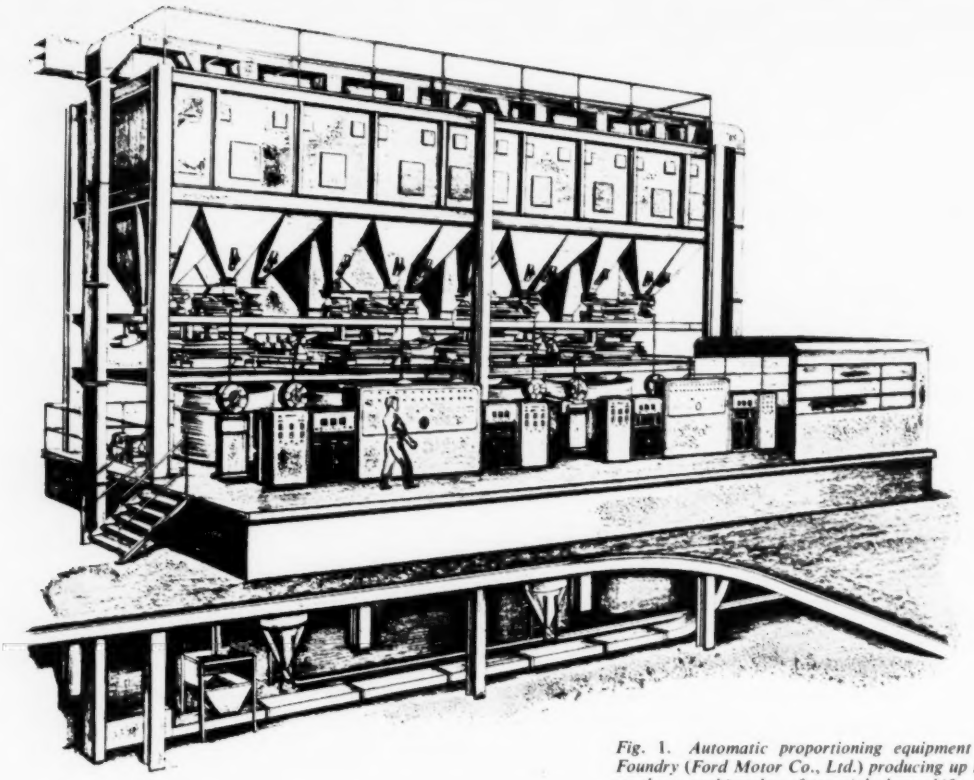


*Fig. 1. Automatic proportioning equipment installed in the Thames Foundry (Ford Motor Co., Ltd.) producing up to 500 tons of bonded core sand per working day of two eight-hour shifts*

Materials handling may be considered to consist of three basic parts:

*Material Form*—a study of the best form or shape of material for easier handling and manipulation.

*Motion Economy*—the study of the movement of operators in relation to the movement of material to minimize effort. It is of little value achieving an economy in a person's movements if the operations could be performed more economically by a simple elèctronic device. An example occurs in colour sorting which can be carried out in some cases by a photo-electric cell, releasing operatives for more important and less tedious work.

*The Application of Mechanical Handling Equipment*—requiring specialist knowledge of the types of equipment available and their particular uses.

Most operations in industry can be classified under materials handling or materials processing. These two technologies are closely related and should always be considered together; the method of processing often determines the method of handling and vice versa. The integration of the processing and the handling leads to uniform flow and makes possible or simplifies instrumentation and control of both handling and processing. Many benefits accrue: productivity is greatly increased; process loading is much improved; inter-process stores and work in progress are cut down to the minimum; bottlenecks are eliminated and the overall pulse of the organization beats more quickly and more regularly. Many other advantages result, such as reduction in accidents to personnel and damage to products, greater uniformity of products and better use of labour and factory space.

**Process Integration**

The essence of process integration lies in breaking down operations into simple basic steps, examining each critically and then making fundamental alterations or adding devices which will allow all the operations to work automatically as a complete system. Wherever possible results are measured and automatic control incorporated as the final aim is to improve the quality and quantity of production while reducing its labour and material contents. It will be seen that process integration is one of the milestones along the road to automation, as shown in the following.

A simpler and less sophisticated treatment of process integration begins with the design of equipment for automatically feeding and unloading machines, not always an easy task and sometimes requiring modifications to the machines themselves. Some process machinery is sold with loading and unloading devices, for example, that used for airless shot blasting which allow castings to be loaded and unloaded while another charge is undergoing the blasting process. When loading and unloading equipment has been designed the next step which follows is linking together various standard machines to form a line. Such a line need not be considered as a permanent installation, rather as an arrangement which can be 'shuffled about' to meet various different demands.

**Production Design**

Many outstanding economies can be achieved by designing components and choosing materials which allow production efficiency to be raised.

**Fuel Technology**

The application of one heating technique, having a relatively lower fuel cost or a higher thermal efficiency is not always the most economic. The main consideration is the overall efficiency of all the operations in a production line, i.e. the production efficiency. Sometimes the application of a technique having a lower thermal efficiency can give a higher overall production efficiency because it may allow, for example, an improved design, elimination of un-

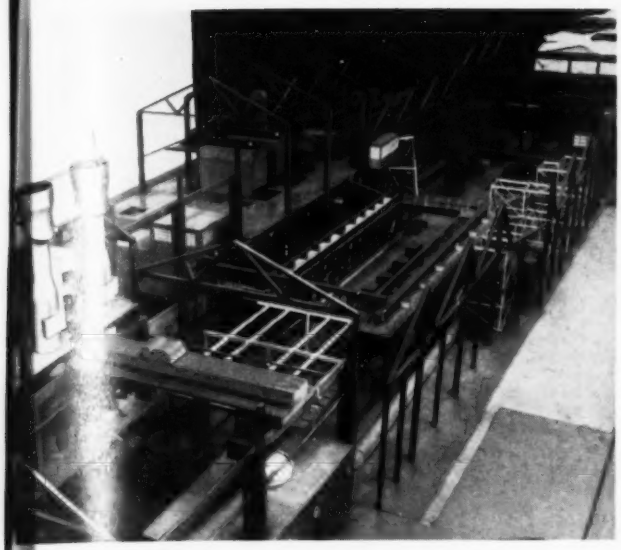


*Fig. 2. Model of Ley's new foundry made on ¼-in to 1-ft scale. View from the melting-bay end, showing cupolas and electric furnace, moulding lines and part of the sand plant, with fettling and annealing department in the background. The floor of the sand plant is made of Perspex*

necessary handling, better use of floor space and improved working conditions.

Modern ways of heating may allow new methods to be used. An interesting example is the portable electric mould drier designed for drying floor moulds or large box moulds for ferrous and non-ferrous metal castings. It operates by forcing hot air not merely over the mould surface but through the sand itself, giving quicker and more efficient drying than is normally achieved with hot gases from fuel-fired stoves. Using air temperatures some 100 to 150 deg C lower than the hot gases, and less than one-third the quantity of heat, it has reduced drying times by a half, and in some cases by two-thirds. The drier needs no attention during operation, the power input is regulated automatically to maintain the desired air temperature. Working conditions are improved by the elimination of smoke and burning gases. But on top of all this there are the handling aspects which can give considerable savings. The problem of moving the mould and putting it in an oven is eliminated together with the attendant risk of damage. Other benefits also spring to mind. Thus, fuel technology must be viewed from an overall perspective.

## Cranes

The principal requirements for foundry cranes are:

1. Speed control of all the motions to have maximum sensitivity.
2. Total enclosure, e.g., of all gearing, motors and controllers against dust.
3. All parts subject to wear to be accessible for adjustment or cleaning.
4. High factor of safety.
5. The electrical equipment to be impervious to heat and dust. Roof temperatures are usually high in a foundry and ventilation of the electrical equipment is important.

Control from a cage is often used where it is necessary to afford the operator a clear view of the hook. Now remote-control systems operated from floor level are being developed so that crane drivers do not have to be housed in bad atmospheric conditions up in a cab on the crane.

Cranes are among the oldest types of handling equipment, familiar to all. There is thus a tendency for the latest developments to be overlooked and the more traditional forms to be used when a modern version would be more efficient. Gantry cranes are among the first choice where loads have to be moved about in a fixed area, though for some applications as in warehousing and raw material storage the fork lift truck has proved a successful competitor in the last decade. A new type of crane has been developed for some of these applications to handle unit loads such as pallets. Beneath and fixed to the gantry crab is a mast on which is mounted a fork lift unit that can rotate and move up and down. The crane is virtually an inverted fork truck. While it has not the flexibility of the truck it does not require the same gangway space and floor surfaces and levels are unimportant.

Electric drives for at least one of the three motions are much more common nowadays; the smaller cranes which formerly had hand-blocks for lifting are now generally fitted with electric pulley blocks. This has an added advantage with underhung cranes which latch up to runways for the electric blocks can then circulate around the runway system. Standard industrial cranes still employ simple line-current drum controllers and standard slip-ring or series motors; there is no close control of the hook, and the load has to be positioned by inching. Where stable creeping speeds are necessary the thruster-operated brake is being successfully used in conjunction with the wound-rotor induction motor on crane drives.

Special-purpose cranes have been made with control gear incorporating numerous modern electrical techniques, including inductor radio and closed-circuit television for

*Fig. 3. Portable electric mould dryer. Using air temperatures some 100 deg C to 150 deg C lower than hot gas drying and less than one-third the quantity of heat, they have reduced drying times by a half and in some cases by two-thirds*

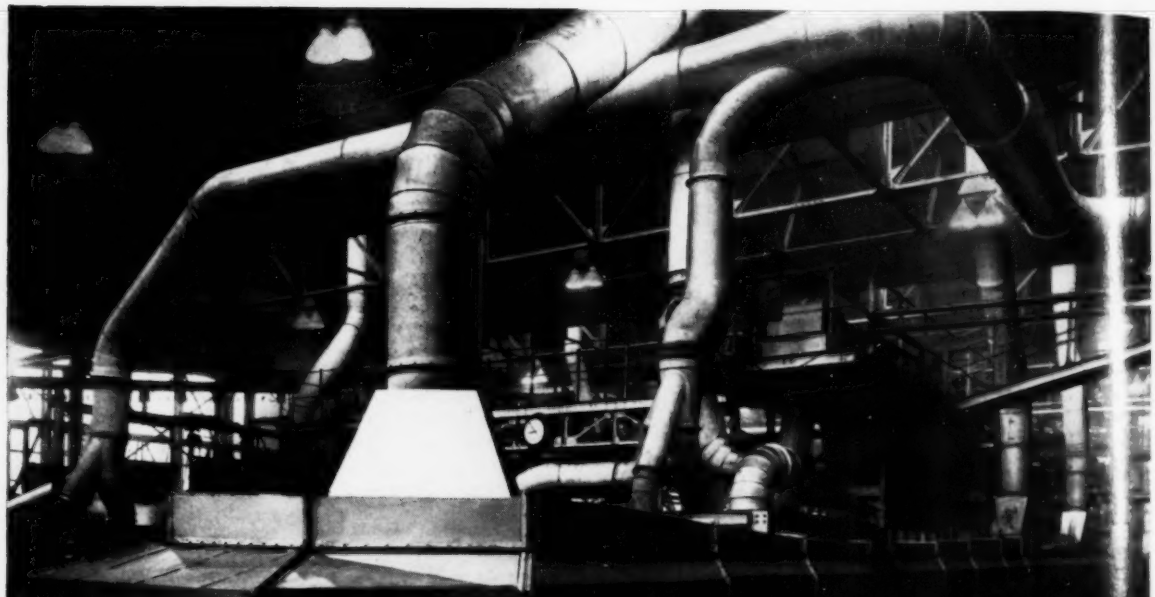


*Fig. 4. General view from the shake-out end of a small mould conveyor showing conveyor hoods, exhaust ducting and part of the shake-out exhaust system (Ley's Malleable Castings, Ltd.)*

remote control and automatic control for process cranes with pre-set programming. Overhead cranes can be operated by two-way radio equipment. A frequency-selector system is also available for remote manual control by means of a single extra wire to the crane.

Accurate control of hoisting and lowering on A.C. supplies is achieved by reverse-current braking and D.C. injection systems. Drives with eddy-current couplings are now being fitted to all motions of cranes giving a speed range of 30 : 1 with all loads. Magnetic-amplifier closed-loop controls are used on the hoist motion. Inching is eliminated and load-handling is speeded up.

Great improvements have been made in contactor gear for steel-mill cranes giving more accurate control and hence speedier working. The Ward Leonard equipment is now being used on cranes to reduce the amount of, or eliminate altogether, contactor gear with its associated maintenance problems. Considerable progress is also being made in doing away with open bare conductors supplying cranes and in safeguarding bare cross-conductors on cranes. Another safety measure recently introduced is a crane-approach system employing high-frequency sonic equipment. The dangers of collisions between cranes and over-running end-stops are eliminated, and complete protection can be given to maintenance men working on a disabled crane or crane track.

Jib cranes mounted on the building structure or on self-supporting columns can be so positioned that an overhead travelling crane may pass over them. They can be used to load and unload machines in the shop, thus freeing the gantry crane for more important duties. By placing adjacent jib cranes so that the areas over which the arms sweep intersect one another, one crane can pick up material deposited by its neighbours and so on along the line.

Cranes have many uses, including handling raw materials, moulds, cores and molten metal, charging cupolas and in the de-coring, dressing and despatch departments. Space precludes any further detailed discussion of the other main types of mechanical handling equipment, applications of which are given in the following sections.

**Control**

There are in general two different methods of control available:

(1) Automatic control. Simple automatic control is exemplified by the limit switch, cam stop or alarm clock. For instance, when the component or part in a machine comes to the end of its travel it presses on a lever or switch and the movement is then stopped. In a typical automatic process, the operations take place according to the way the equipment is initially set up. If wear in the plant occurs or faulty material is fed in, the process continues operating until stopped. There is no element of automatic correction in the system.

(2) Fully automatic control employs basically a control unit, a sensing device and an actuator. The method of operation differs from that in (1) above, in that the sensing

device inspects what is being produced, or happening, and sends the information to the control unit which compares it with the results which should be obtained (called the program and which is pre-set). If there is a difference between the two the control unit operates the actuator in the required manner until the process is producing material according to the program specification. In other words the process is self-regulating and is said to employ 'feed-back' or 'closed-loop feed back'. Illustrations of closed-loop feedback control systems occur in the human body, for instance, when the hand reaches out to grasp an object, the sensing device in this case being, of course, the eye.

The statement has been made that 'in fact the automatic customer should perhaps precede the automatic plant', but this does not apply in the case of a fully-automatic or automated plant. One of the great advantages of automation is that an automated system can economically handle batch production, for, by simply altering the program, possibly by rotating a knob, the output from the plant can be immediately changed within the limits imposed by the processing plant.

**Input of Information**

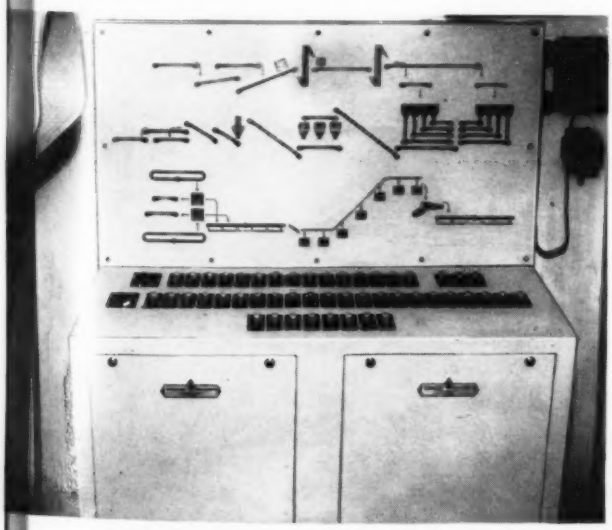
Most people are familiar with the cam and camshaft method of programming processes. It is essentially a time-multiple-sequence device. The cams operate various items in a time sequence according to the angles of the cam positions on the shaft. To change the sequence requires a re-positioning of the cams and possibly an addition to or a subtraction from their number. Electronic timers have replaced the camshaft in making up a load from a number of different constituents and are also used on automatic moulding units. Other methods are being used increasingly in industry, particularly equipment controlled by punched cards. Punched or magnetic tape is now used for controlling core sand mixes as is described above. These methods permit great flexibility, for large numbers of cards can be kept in a small space and the information can be placed in the punched-card reader in an extremely short time; it only takes a moment or two to punch a new card when a new series of instructions is required.

**Motive Power**

The electric motor is the muscle in the mechanical handling arm. Care is needed at the design stage in the choice of drives to give the most effective results. Variable speed drives can be broken down into two main types. The variable speed drive with a stepped—usually fixed—speed range and the infinitely variable unit. There are several ways of obtaining infinitely variable speeds by mechanical, hydraulic, electrical and electronic methods. A great advantage of electrical and electronic methods is that they well lend themselves to centralized control and one 'master' control can vary the speeds of all the separate drives in a system. Subsidiary controllers can, of course, regulate the speeds of individual drives. One man at the main control panel is able to speed up or slow down the whole plant or individual machines as required. These systems can incorporate automatic sequence control for starting up or shutting down the plant. A practical example of the correlation of the speeds of two conveyors in foundry working is provided by the following. Moulding boxes from the shakeouts are conveyed by a slat conveyor, the speed of which is related to the speed of the mould conveyor. When the speed of the mould conveyor is varied so is that of the slat conveyor.

Centralized control is being more widely used in all types of industry to-day. Figure 5 shows a control console with stop and start buttons for every conveyor in a foundry. All the conveyor plant in the moulding, shakeout, cooling and sprue-removal sections is controlled from this desk by push-buttons. At the back of the desk is a mimic diagram with an illuminated representation of each unit in the plant.

*Fig. 5. Control console, with stop and start button for every conveyor in a foundry. At the rear of the control is a mimic diagram, with indicator lamps. The console is housed in a cubicle which is formed beneath one of the sand-distribution conveyors (Ley's Malleable Castings, Ltd.)*



**Instrumentation**

Before any form of control, manual or automatic, can be accurately applied some form of measurement using sensing equipment and instruments is necessary. Thus, instrumentation is one of the first steps towards automatic control. Sensing equipment observes what is happening and transmits the information to a control device—it acts as an inspector and thus endows the whole system with a sensibility of a predetermined nature. The physical characteristics of material, its dimensions, weight, colour, temperature and, in some cases, its composition can be observed. In theory, this can be done in batches or continuously. Continuous sensing for several applications to-day presents some difficulties but technological advances are being made, albeit not as rapidly as some would like to see.

An interesting development is the load cell which is essentially a billet deforming when subject to compressive loading. Within the elastic limits of the billet material, the degree of deformation is proportional to the applied load. The strain set up within the billet material is measured by current-carrying strain gauges bonded to it. The cells can be used for a variety of purposes, e.g., for weighing tanks, bins and hoppers. They are also used for weighing any loose material continuously on a belt and a minimum weight of about 10 lb per running foot of conveyor is suggested with a tare belt weight of not over 30 per cent of the total weight.

There are few, if any, meters on the British market which can continuously measure and record the moisture content of foundry sand. A new equipment is approaching the production stage which will continuously measure permittivity, or dielectric-constant of sand. Because there is a definite relationship between this electrical property and the moisture content it will give a direct reading of moisture content when suitably calibrated. In America, General Motors' Central Foundry is using plutonium 239 for this measurement. The technique they have developed uses fast neutrons emitted from plutonium mixed with beryllium powder and sealed in a stainless-steel capsule. The measurement is almost entirely automatic, the radio-active source being lowered through a stainless-steel tube into the centre of each 30-cwt batch of moulding sand in a hopper. The

moisture content is indicated in 45 seconds on a large dial which also shows the quantity of water needed. The mill operator presses a button to drop the sand from the hopper into the mill and with a second button measures the amount of water required. The accuracy of this sand moisture gauge is reported to be better than $\pm 0{\cdot}05$ per cent by weight over a range of 2·5 to 5·0 per cent total moisture content.

Radio-active isotopes are a new tool for management and are coming into their own in industry by providing solutions to a wide variety of production problems. There are three qualities of isotopes which are used industrially:—

(*a*) Penetrating radiations used in thickness measurement, level control, radio-graphic examination and quality control.

(*b*) Tracer qualities used to detect the presence of a material.

(*c*) Ionizing effects which the radiations have upon air.

The quality (*a*) has several applications in the foundry. For example, in addition to the conventional volume, temperature and gas-analysis indicators and recorders on cupolas, charge-level indications giving 'high' and 'low' signals might be undertaken by using a radio-active source, such as cobalt-60.

The method of working of light-sensitive or photo-electric cells is simple; the incidence of light on the cell affects certain of its electrical characteristics, changes in which are used as input signals to some electrical, electronic or pneumatic equipment. The cells are 'optical observers' and, in effect, light actuated switches. An example of use is the operation of pneumatic rams which push off cooled moulds from conveyor-car tops. The cells are so arranged that the mould is correctly aligned before it is pushed off on to vibrating rails forming part of a specially adapted vibratory conveyor which support the box parts only, and allow sand and castings to fall clear of the box on to a shakeout grid.

Capacitance controls are much used in industry and are marketed under such trade names as 'The Tektor'. A probe, or probes, is connected to a control unit and an indication is given when material comes close to it. This indication can be used to operate an indicator lamp, a switch controlling a motor, or a conveyor plough. Capacitance controls provide a good method of level control for solids and liquids and do not suffer from some of the disadvantages of light-cell working, e.g., those of light reflections and dust. One widely used application in the foundry is the automatic filling of sand hoppers. In each hopper there is an upper and lower probe and above the hoppers runs a belt conveyor with a plough for each hopper. When the bottom probe is uncovered the plough is operated and the hopper is filled until the top probe is covered when the plough is returned to its neutral position. In this way a line of hoppers is automatically replenished and no man has to wait for material.

The repeater is an electrical instrument for transmitting information to a distant point. Various measurements can be repeated: electrical quantities, e.g., amperes, volts, watts —steam and water pressure and flow—degree of opening of valves and weight of material passing on a belt. The summation of two or more measured quantities may also be undertaken. Instruments like these allow information to be sent to a centralized control point. Management is then in a position to take action immediately to remedy any variation from the programme laid down.

Remote indication is used for charging cupolas. In one installation a fully-automatic charging sequence needs only one man for its control. Charging is initiated by the driver in the cab of a 5-ton gantry crane, which spans the stockyard and with which the unloading of trucks of raw material is also effected by a magnet and a grab. The operator using the magnet first, weighs the metal charge in the weigh hopper and the actual amount is indicated to him by a repeater dial in his cab. When a charge is needed he simply presses a button which then sets the following train of operations in motion. The weight of the hopper contents is recorded, the contents then fall into a charge bucket which moves along and is automatically filled with the correct quantities of coke and limestone from hoppers. The charge bucket then automatically discharges its contents into a cupola. Incidentally, a charge-weighing accuracy of about 1 per cent is claimed for this installation.

**Automation**

Automation can often be introduced in a number of stages, with the savings of stage one financing stage two, and so on. Let us take as an example the method of introducing additives to core sand. The traditional method of introducing them was by shovel or bucket from a sack or barrel. The first development would be bulk storage and manual feeding into the process. The next development would be manual control into a weigh hopper, then automatic control from push-button, finally, punched-card control and a fully automatic process. Some recommend that it is better to reach the stage of full automatic control by steps over a period of time not only from the practical viewpoint, for fully automatic plant presents a number of technical and commercial problems.

There does not appear to be any commonly accepted definition of the word 'automation'. In industry 'inter-linked' machines or transfer machines are commonly considered to come within the category of automation even though they do not employ fully automatic control. An elementary form employs an indexing table which rotates through 360 deg and around the circumference of which work stations are mounted each undertaking a separate operation. These types of machines are used for machining and assembly operations. The principle is used in the

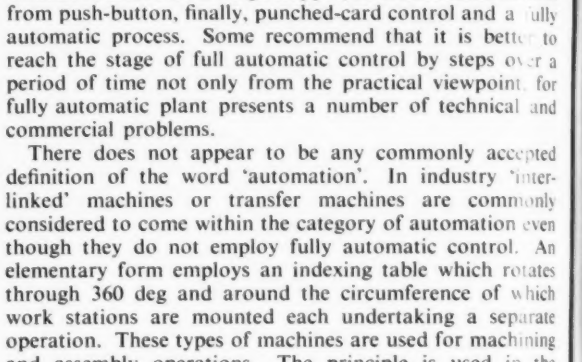



*Fig. 6. Close-up of the automatic shake-out unit for the small mould line. The push-off ram has just transferred an 18 in by 13 in mould to the vibrating rails. Also shown is the grapple for transferring knocked-out boxes from the vibrating rails to the live rolls. The operating photo-cell can be seen on the right (Ley's Malleable Castings, Ltd.)*

Hallsworth Automatic Moulding System. In this system the basic machine has four stations and a rotary table which automatically conveys the half-box and pattern from station to station. An operator is necessary to (1) visually examine the pattern plate, and clean it with a compressed air gun if necessary; (2) position the box part; and (3) bring down the sand allowance frame. None of these operations is fatiguing to any great extent, and all the essential moulding operations are carried out automatically.

A high degree of process integration or interlinking of machines is evident at the foundry of G. Fischer A.G., Schaffhausen, which operates on clay-bound sand. In this plant there are automatic moulding machines, devices for inverting the mould parts from the moulding machines on to the conveyor belt and for putting copes on drags, chain conveyors for putting on and taking off mould weights, and mechanisms for casting. Of interest also are the cooling belt, the shake-out station, the return tracks for empty flasks and the sand-dressing installation consisting essentially of the devices for cooling and mulling the shaken-out sand. The plant is intended to produce small and medium-sized castings under European market conditions of small runs, high pattern-casting price ratio, strict requirements about quality of castings and great diversity of shapes and sizes of castings.

Some interesting developments and trends are to be seen in one pressure die-casting plant with the near-abolition of manual handling. Flow line methods have been used though the foundry is on jobbing work. One of the more important features is the metal melting plant. Two main melting furnaces (low frequency induction) of 60 kW are employed, one at each end of the line of die-casting machines. Each machine is equipped with a 20-kW holding furnace and the whole system is inter-connected by a series of electric resistance-heated launders, along which the molten metal finds its own level throughout. The resistance heaters are housed in hinged sheet-steel covers of the launders and have a sufficiently high rating to keep the metal in the channel molten whatever the flow. Labour costs are restricted to the feeding of the main melting furnaces only. Metal losses during melting have been found to be as low as 0·3 to 0·4 per cent, and the whole system is particularly cool and clean in use. In this plant overhead indexing chain conveyors are used for linking the die-casting machines with the trimming lines and for providing storage. Trimming is carried out on belt conveyors and a specially designed 'below floor' conveyor is used to take scrap back to the vicinity of the main remelting house.

In another foundry a conveyor system handles the raw material. Duplex stock bins each allotted its own material are situated by a railway line and parallel to a foundry wall. They are filled with pig or scrap direct from rail wagons or from the stockyard by overhead crane. An overhead chain conveyor of 11 tons loading with 22 buckets, each having a scale weigher and marked for the type of charge, has a capacity of 22 tons/hour when running at 14 ft/min. There are two drives of 4 h.p. and 8 h.p. The conveyor travels along the row of stock bins and rises a total of 30 ft into a charging bay (the floor of which is 19 ft above ground) and passes along in front of cupolas 3 ft 6 in above the charging-level sill. It then leaves the bay and runs down the side of the foundry passing over a device at floor level which automatically closes the bottom doors of the weigh hoppers, thus completing the circuit. Mounted on the charging platform in front of each cupola is a charging machine consisting of a short cone chute and a charge bucket of the same capacity as the weigh bucket which is pushed into the cupola at the end of a pneumatic ram having a 6-ft stroke. A single operator on the charging platform stands at a remote control panel, so positioned to give him a clear view of all the cupolas. As the filled buckets pass along in front of the cupolas, he selects the one required, and by means of a pneumatically operated cam opens the doors of the weigh bucket to drop the charge into the appropriate charging bucket. This latter is then traversed into the cupola and discharged as required. The empty charging bucket returns automatically and is ready for receiving the next charge. Three loaders and an operator are in attendance. The stock bins have an approximate capacity of 50 tons. Those containing foundry return scrap are automatically replenished from tip-up pendulum buckets which alternate with casting buckets on a pendulum-type cooling conveyor that runs outside the foundry adjacent to the bins.

*Fig. 7. Overhead view of automatically operated ploughs feeding sand to the moulder's hoppers on the small mould line. Some of the controlling probes can be seen, projecting downwards into the hoppers. The length of these probes is arranged to ensure adequate supplies of sand at the machines, while preventing the hoppers filling much above half capacity—a set-up designed to reduce sticking of sand. (Ley's Malleable Castings, Ltd.)*

The Sand Rammer is a valuable tool for the jobbing foundry and lends itself to a degree of automation. The simplest type which might be applied to it is 'play-back control'. Briefly such a system records all the operations and their times performed by the operator over one complete cycle. The control can then repeat ad infinitum the recorded cycle without any human intervention other than starting it. Any number of different cycles can be recorded on one or more tapes and a selecting system could be designed to find quickly the correct part of the tape for a given-sized mould box. Control of this type has been applied to machine tool work. Punched tape or punched card might provide alternative methods of control.

Looking further into the future it might be possible to

carry out the mixing of the moulding sand, etc., actually in the sand rammer—then the tape or punched card could control not only the movements of the rammer, but also closely the composition of the sand leaving the rammer.

Automatic proportioning equipment installed in the Thames foundry produces up to 500 tons of bonded core sand per working day of two eight-hour shifts. For the proportioning and preparation of an individual mix of one ton, a period slightly less than three minutes is all that can be allowed. Ten differently proportioned basic mixes have to be catered for and, to meet possible variation in the physical properties of the ingredients, each mix has to be capable of rapid detail adjustment. The mix is accurate to within 1 per cent of specification.

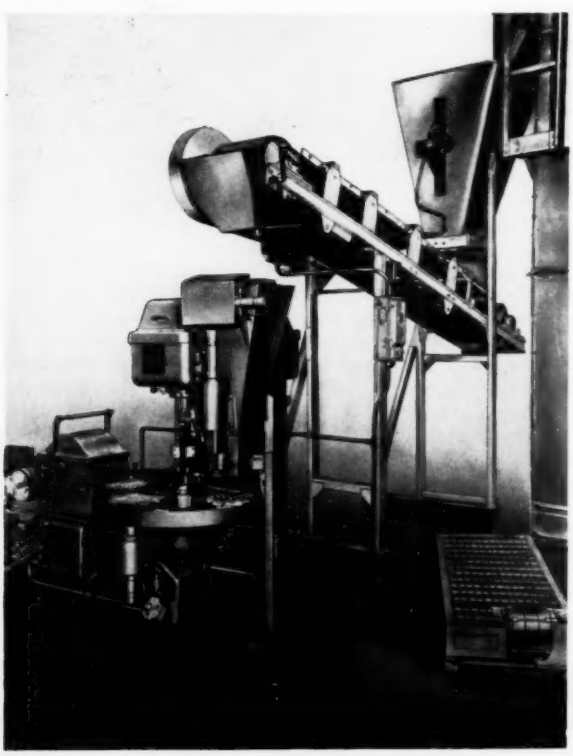
The plant consists of four batch-weighing groups to handle the proportioning of the dry sands and additives brought to the plant by Redler conveyors and held in storage hoppers with compartments holding two types of sand and three additives. Two scales with weigh hoppers, for each of the four groups, are provided—one for sand and the others for additives. On each group three metering pumps are time-cycled with the weighing equipment to deal with liquids—water and two oils. Mixing is effected in August-Simpson Mix-Mullers, and the bonded sand is delivered to the selected core-blowing machine by a Crane turbo-drive pneumatic conveying system.

The 10 basic mixes are contained on punched cards and a variation of any mix is obtained by altering the pattern of the card punching. The automatic cycle is initiated by insertion of the punched card in the drawer of the Oerlikon cabinet. The vibratory feeder starts delivering the first material to the weigh-hopper. The second ingredient is fed in after the first weight has been delivered. At the same time the additives are similarly weighed and when the sand weighing cycle is completed, the bond weigh-hopper discharges its contents into the sand weigh-hopper. While the weighing is in progress, the metering pumps transfer pre-set volumes of water and two oils from the storage tanks to two blow tanks. When the start button is depressed the dry materials are discharged into the muller and the mixing cycle is started. After a period of 10 seconds, the blow tanks discharge the liquid additives, under air pressure, into the muller. The final mixing sequence is timed and monitored by the mix timer.

When the mulling is completed the mix is discharged automatically into the turbo-drive system. At this stage the plant holds a finished mix in the turbo-drive equipment awaiting delivery, another mix is in progress, and a further batch is being proportioned.

The hopper of the core-blowing machine requiring sand is indicated by instrumentation on the control panel and by the selection of the appropriate numbered button, the mix is supplied to it. For test purposes or in the event of any failure or malfunction of the automatic system operations can be manually controlled. The approximate cost of such an automatic sand preparation plant is between £100 to £150 per ton day. Thus a plant having an output of 100 tons a day might cost between £10,000 to £15,000 and one of 500 tons a day between £50,000 to £75,000.

*Fig. 8. Hallsworth Automatic moulding system*



**Design of Plant**

To take full advantage of the benefits that these new techniques, such as electronics and automation can give, it is necessary to make an overall appraisal of the whole method of working. Usually the best results are not obtained by considering separately the designs of control and instrumentation and of the process and auxiliary plant. Experience teaches that they should be designed as one integral unit. A modification or, indeed, often a radical change in processing methods is sometimes necessary in order that automation can be applied.

**Research and Development**

Companies both large and small have found that production research and development pays off. There appears to be no shadow of doubt either that these companies are leaders in the application of electronics and automation. In these days of rapid technological progress no organization, however small, can afford to rely entirely on its equipment suppliers for improvements and developments. A beginning has been made in some companies with Work Study Departments. Often these departments have grown in technological competence but really their most important function has been in releasing people from day-to-day duties and thus giving them 'thinking time'. The most progressive firms have ensured that these departments have been responsible to a director or senior manager. It has been surprising too, what economies these departments have been able to make when new plant was ordered.

**Obtaining Information**

There are many sources of valuable information freely available in the United Kingdom; Government departments such as the Department of Scientific and Industrial Research, research associations, development associations, for example the Electrical Development Association and Universities and Technical Colleges are just a few. Many of the Electricity Boards have industrial advisory services, staffed by highly qualified electrical production engineers, set up to give free and unbiased help in the industrial applications of electricity, including electronics.

1960 JOHN MORRIS MEMORIAL AWARD WINNING ESSAY

# THE INDUSTRIAL TRUCK OR INDUSTRIAL NECESSITY

by R. J. BUNN*

Upon the death of John M. Morris the British Industrial Truck Association founded the above-mentioned Memorial Fund. This is the winning essay of 1960. It entitles the winner to attend the Materials Handling Course, Lake Placid, U.S.A.

It is, perhaps, a bold statement, but one which can be justified, to say that industrial trucks are necessary to industry and our modern economy. Take them away and substitute, if you can, alternative means of mechanical handling or find sufficient available labour. Industry would, without a doubt, survive, but to choose a realistic simile, it would be comparable to preventing a man from using his legs; he would ultimately overcome this disability but movement would be much slower and difficult manœuvres would have to be given far more thought.

We can define an industrial truck as a mobile unit used in industry for transporting, and often lifting and positioning, objects which are normally either bulky or heavy, with or without power assistance and within the boundary of a particular works area.

Records are unenlightening, but it is fair to assume that since the beginning of industry or, in other words, since the Industrial Revolution, there have been objects which, because of their size or weight, could not be moved by humans and therefore some unit within the definition of industrial trucks existed at that time.

War and economics play a prominent part throughout truck history commencing from the invention of wheels which were part of the Bronze Age economy and were associated with bronze tools and weapons.

The fight for survival brings conditions of co-operation and urgent thinking not possible in normal times. Even in our recent history we saw the fork lift truck re-introduced to Britain by the American Forces during the Second World War. It stayed to be used very effectively as an essential tool in the post-war era in the fight to stabilize our national economy.

By 1951 a Board of Trade Census of Production showed that fork lift trucks represented half the total output of industrial trucks in this country. We should, therefore, reflect on the fact that the fork lift truck was 're-introduced' in Britain during the war and we were dependent once more on America to show us the value of a major invention because, although research failed to establish who actually invented the fork lift truck, there seems little doubt that it was a British invention of the 1910 period. One can assume that it was not an invention as such but a gradual development of a lifting platform, by necessity being made mobile to reduce manual effort. It is also considered that its origination is from the agricultural world where it was an attachment to a tractor.

It is, however, a fact that a British manufacturer was producing battery-electric powered tiering trucks in 1932 which were fitted with elevating platforms. Tiering, as the name suggests, is to arrange layer above layer but the operation of this truck was purely to elevate a load to a required height and, from there, it was transferred to a stack or vehicle manually.

Tinplate manufacturers were, however, quick to recognize the potential of this type of truck and the tinplate tiering truck together with the unit load were born in 1926 and subsequently accepted throughout the tinplate and steel industries.

The main features of these trucks were, of course, the forks which passed under the wooden stillage, which if correctly defined, would be called a single-decked pallet, and made mechanical stacking and vehicle loading possible. Clamping arms were attached to the fork carriage which mechanically clamped the stillage of tinplate, thus allowing safe transportation of loads weighing up to 2 tons.

To-day, the truck would be described as being built like a battleship and weighing twice as much but, for all that, we can still see these trucks doing very useful jobs in a number of factories which is certainly a credit to the manufacturers. The illustration shows the extremely heavy construction and rigid mast assembly. The mass amidships is the housing covering the bulky batteries.

The economics achieved by introducing these trucks into one particular factory to replace combined crane and manual handling showed that one truck and operator handled three times the volume previously handled by two men. Furthermore, in addition to the safety aspect, the 1-ton unit required one wrap only instead of up to 10 individually wrapped boxes of the manually handable unit and last, but not least important, was the fact that road and rail vehicles were turned round in far less time.

Again at this time, platform trucks were very much in evidence. Battery-powered types would answer to the same slang description as the tiering truck and had a similar stand-on operation and power unit. The batteries were slung between the wheels under the platform.

Many other types of trucks were in existence such as tractors and a variety of hand trucks but, as this paper is restricted in length and deals with past, present and future developments, we must pass them by.

**Post-war development**

The writer first came into industry as an apprentice in 1943 and can now refer to personal experience of the post-war development of industrial trucks.

It is, perhaps, worth mentioning as an aside that the first

*The Metal Box Co., Ltd.

industrial trucks which made an impression were 'do-it-yourself' units pulled by Progress Chasers which were constructed of board mounted on four castors with a piece of cord as the pulling medium. These 'trucks' conveyed bins of urgently required radio components to assembly benches and, no doubt, saved the Chaser much effort throughout a day's work, or it could well have been that the incentive to use it was a personal economy factor in that it saved wear and tear on his suit which would have been a feature of lifting and carrying.

The study of materials handling was recognized during the war as an aspect of industry which could speed up the production of equipment urgently required but, once introduced, its value became obvious and it therefore continued in peacetime when economics became the driving force for industrial development.

We know that handling can amount to over 50 per cent of the cost of a finished article and the post-war industrialist was quick to see this as a specialist's function and created the position of Materials Handling Engineer whose function it was to:

1. Develop and implement new labour-saving techniques, schemes and equipment.
2. Select, procure and maintain mechanical handling equipment.
3. Liaison with transport controllers, commercial managers and customers on all handling problems.

The aim was to reduce the cost of the product and, by minimizing damage, to improve the quality.

During the period 1945-1950, we were fighting for our share in world markets to stabilize our national economy by reducing the export/import gap and also accumulate repayments for our war debts. Rising labour and material cost together with the introduction of the five-day week to improve the British workers' standard of living still further were the factors which were now challenging the ingenuity of the Materials Handling Engineer.

All forms of mechanical handling equipment manufacturers began to spring up to meet this challenge and particularly noticeable were the industrial truck manufacturers. However, much credit must be given to the Ministry of Supply who, immediately following the war, approached a number of companies they considered could undertake the manufacture of fork lift trucks of a similar pattern to those provided in this country by the American Forces and, subsequently, placed orders for trucks to be used within Royal Ordnance depots. These particular companies now rank high among our leading industrial truck manufacturers.

The demand for the output of this industry is clearly illustrated by the graphs produced from returns made to the Board of Trade.

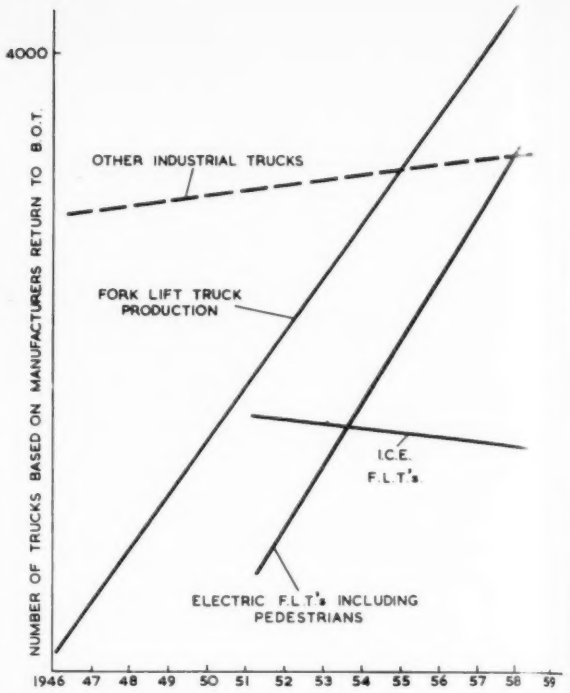

4000
NUMBER OF TRUCKS BASED ON MANUFACTURERS RETURN TO B.O.T.
OTHER INDUSTRIAL TRUCKS
FORK LIFT TRUCK PRODUCTION
I.C.E. F.L.T's
ELECTRIC F.L.T's INCLUDING PEDESTRIANS
1946 47 48 49 50 51 52 53 54 55 56 57 58 59

*Fig. 1. Straight line graph illustrating the trend of production output of industrial trucks*

We should mention here that the fork lift truck made palletization possible which has, without a doubt, given industry the biggest economy within the scope of materials handling.

All this development is, of course, directly related to automation and improved production techniques because many inter-operational handling problems have been and are being overcome by automatic transfer mechanisms being incorporated in machine designs.

From this the question arises, 'Why were trucks so successfully developed in the face of competition from other rigid forms of mechanical handling equipment which would quite well satisfy many applications which were a function of the truck?'

Firstly, it is realized that in certain industries such as the car industry, a line is laid down to produce a model over a period of time which it is calculated will repay capital costs of tooling and line equipment and it is in these instances, where known components travel over set paths, that the truck will give way to rigid forms of handling equipment.

In industry generally, however, development and expansion are so continuous that rigid forms of equipment would be a severe handicap or, indeed, one big headache due to the high capital costs which are generally involved.

The basic requirements of our 'Industrial Necessities' are versatility and flexibility for a comparatively small capital outlay.

**The present industrial truck**

From the developments previously mentioned, we can see the pattern of requirements which the industrial truck has to meet.

The jobbing work-in-progress operations have been reduced and line speeds increased two- or three-fold, and, with very few exceptions, all finished products pass through

**JOHN MORRIS MEMORIAL FUND**

*John M. Morris was sales director of Coventry Climax Engines, Ltd., when he died in 1958. He was prominent in the development and growth of mechanical handling in Great Britain and the Commonwealth, particularly with regard to the utilization of the fork truck. From October 1954—February 1957 he was chairman of the British National Committee of the Fédération Européenne de la Manutention, and, following the reconstruction of the British Industrial Truck Association, he was appointed its first president. He was the author of a number of papers on mechanical handling and presented a paper at one of the conventions run concurrently with the Mechanical Handling Exhibition.*

packing areas to stores or despatch. Also it has been found that it is more economical to build stores or warehouses higher than to expand their area. Gangways which have in some instances occupied up to 50 per cent of the total area therefore wasted more cubic space and had to be reduced.

Faster vehicle turn-round times were essential to reduce transport costs by increasing numbers at length of daily journeys. All these factors influenced the design of the Industrial trucks we have in use today.

### Fork lift trucks

Let us first deal with the main aspects of the development of the conventional fork lift trucks which we know, quite rightly, as the 'maid of all works'.

We saw two types emerge during the early post-war period. One, by virtue of its construction, was obviously developed from the tiering truck. The other, developed by the newcomers to the industry and which was based on experience gained in the car industry, incorporated many car components.

Both of these trucks were gradually moulded into their present form by the necessity to keep the overall dimensions to a minimum without reducing stability and to reduce long maintenance down times by better design and materials also improving the get-at-ability to parts or components which regularly need attention.

In the I.C.E. trucks, double reduction differentials were designed with final drive gears manufactured from 75-80 ton tensile steel instead of the single differential which was produced from 30 ton tensile phosphor bronze.

This not only eliminated a source of weakness but was instrumental in lowering the centre of gravity to give improved stability. Constant mesh gearboxes gave smoother operation and longer life. Brake linkages were eliminated by coupling the operating pedal directly to the hydraulic cylinder and the brake drums designed to facilitate adjustment without removing the wheels. Clutches were completely redesigned to make a clutch plate replacement possible from between $\frac{1}{2}$ to 3 hr instead of anything up to 16 hr. Better designs reduced the unladen weight ratio which originally was 60-70 per cent on the steering wheels to 53 per cent to give improved manœuvrability and reduced operating fatigues. Tilting masts gave safer transportation of materials and made entry and withdrawal from pallets easier. New high lift masts have been developed and the standard 9 to 12 ft masts will gradually give way to 16 to 20 ft lift units. Lifting speeds are also faster. Cushion tyres have been developed to give the combined qualities of solids and pneumatics for general factory and warehouse use and, where fitted in place of twin pneumatics, gives the added advantage of reducing the overall operating width of a truck.

*Fig. 2. Tinplate tiering truck*

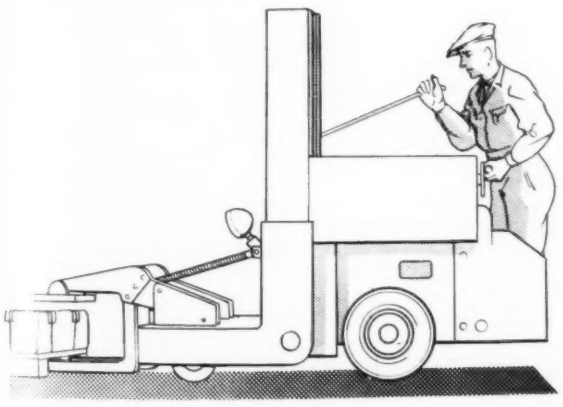


*Fig. 3. Present fork lift truck*

In the battery electric range of trucks, we have seen a remarkable development in battery design to give reduced size and increased capacity. The new tubular cell battery which has recently been introduced to the industrial truck market as a replacement for existing batteries is claimed by the manufacturers to give a further 35 per cent increase in capacity and life without increasing the carcase size.

These developments have made it possible to reduce the overall truck dimensions, give improved traction and lifting speeds with higher lift masts.

Battery trucks are now capable of operating a full day's hard work inclusive of overtime without any anxiety of how much longer will the battery last.

Returns to the Board of Trade since 1951 have shown a breakdown between I.C.E. and electric fork lift trucks and this is shown on the graph illustrating the industry's output.

It should, however, be remembered that the electric truck figure includes a proportion of pedestrian controlled units which for 1959 represented approximately 20 per cent of the total.

The parallel development of I.C.E. and electric trucks is leading to greater standardization and, therefore, economy within this industry and we now see one manufacturer offering a range of petrol, L.P.G., diesel and electric trucks built on a common chassis and proud of the fact that the heel of fork to balancing point dimension is also common to all. A minor, but nevertheless, important feature is the detailed thought given to the ergonomics of grouping controls for better control and speeds.

Non-conventional trucks, as we call them at this time, have appeared in the form of side loading trucks for the heavier industries, straddle and reach trucks for lighter industries. The reach truck merits a special mention, particularly as it can be claimed as an original British development.

The 'reach' principle of this truck eliminates the need for a heavy counterweight by carrying the load within the wheel base of the truck and, therefore, when transporting or manœuvring into a stack, the overall length is considerably

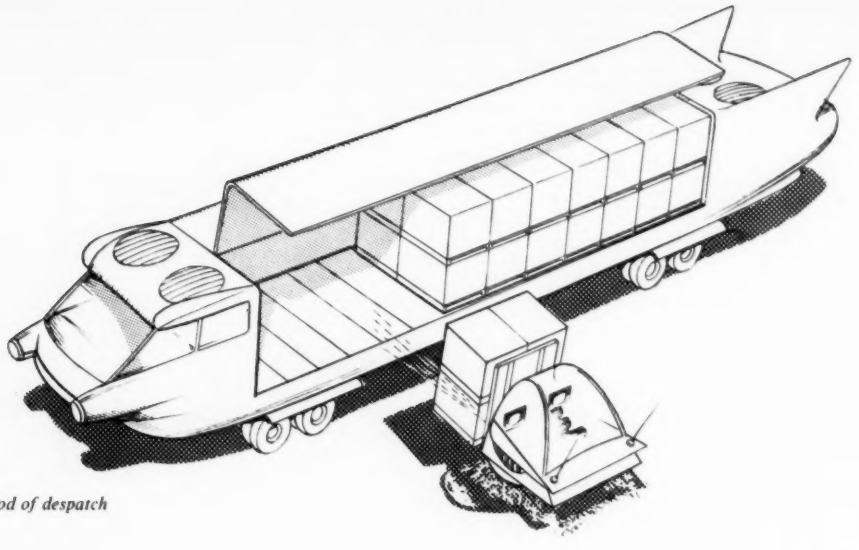


*Fig. 4. Future method of despatch*

reduced. Hence, this truck will operate in gangways 40 per cent smaller than those required for the conventional truck.

However, due to the additional 'reach' forward and back movement and the slower traction speed which is common to all electric trucks when compared to I.C.E. trucks, the scope of this truck, at present, is confined to operation on production areas where gangways are limited and in the slower moving warehouses or stores. Tyres are again worth a special mention and Duthane tyres can be fitted to these trucks which have the combined qualities of steel and nylon. To the user, this means increased tyre life and decreased floor wear, and tests have also shown improved battery consumption. This tyre is only recommended for use where floor conditions are considered to be good as it lacks the resilient quality of rubber.

Before moving from the fork lift truck, we should briefly consider the wide range of attachment which are available to increase still further its versatility. These range from the simple jib attachment and sideshift attachment, which are now quite a common feature on trucks, to the special attachements such as side clamps and skid pads, which obviate the necessity of pallets, to the more complicated rotating head reel clamps and coil handling units.

A further refinement available and more commonly used where a factory is spread over a large site, is the radio telephone. The R.T. manufacturers claim that by introducing a system where eight trucks were employed only seven would be required because the constant control enables useful employment of otherwise empty return journeys and the selection of the nearest truck for a particular job.

**Other trucks**

The development of other powered trucks followed a similar pattern to the fork lift trucks with a noticeable trend towards standardization of power units.

To-day we see very little of the two operators struggling to pull a hand truck, and, indeed present day workers do not expect to be asked to do this type of labour.

From management's point of view, the necessity to reduce labour costs has led to the increased use of the power truck, as our graph illustrates.

The manual trucks, however, still play an important part in industry and will continue to do so particularly where it is necessary to remove goods from work places to buffer pick-up areas as it cannot be economical to have relatively expensive units waiting for indeterminable jobs.

Hand trucks of to-day show the benefits of improved design and materials and full use is made of folded steel sections, nylon or Duthane wheels and leak-proof pump units which are also a quickly removed change part.

Also under this classification is the sack-barrow or, more correctly it is known as the two-wheeled hand truck and is probably the most generally used truck in and out of industry. This unit has undergone minor improvements to wheels and handles but more recently we have seen it developed into a stair-climbing truck.

From this down-to-earth development, let us start looking ahead to the industrial trucks of the future.

**The future fork lift trucks**

We have in the past seen articles by leading industrial truck engineers giving their impression of fork lift trucks of the future. Some of their designs were definitely related to flying saucers on wheels but perhaps we should not pass this dream over without further thought. Let us seriously consider the possible developments foreseeable within the next decade or two.

The future trucks will still be related to certain known facts. Stacking aisles will still be related to pallet sizes which will, no doubt, grow in bulk but, basically, retain their present form. This, in turn, is controlled by the despatch vehicle, be it road, rail or any other form of transportation, and, in the former case, the vehicle itself will be related to road development and that, we know, gives no indication of being revolutionary and this is also applicable to railway development.

There are, however, definite reasons why we should look to the new development of the hover craft and its potential as a new mode of despatch.

Let us start from the hover craft vehicle as a means of despatch to the internal factory truck.

Our present knowledge of the prototype craft, which operates on the principle of a downward thrust of air to suspend and propel the craft, would not permit great operating heights. Nor would it be possible to pass over houses without blowing soot down chimneys or washing off the line.

We could follow the more determined approach which has recently been given to the building of motorways and consider cutting wide paths through the countryside to link up cities and major towns, but no surfacing would be required. The hover craft could then cruise over these paths at speeds of 100 m.p.h. or, perhaps, more.

To pass over built-up areas, overhead strips could be built which would be capable of withstanding the thrust of these craft. Safety refinements, such as guiding beams for the craft to follow and controlled passing points would be included in the scheme.

Two types of craft could be employed, the first of, say, 200 ton capacity and equivalent to our present train, and the other of 20 ton or equivalent to a road vehicle. The latter would be adaptable and, where necessary, use existing roads in the normal manner.

The new type of craft would not require large areas of hardstanding at factories which can represent an expenditure of over £30,000 for an area of 10,000 sq. yd., this including cost of ground, lighting and fencing.

Having overcome a national problem with this new form of transport, we are now faced with an industrial problem of loading to the craft which can be resting on an under-surfaced area. The simple solution to this problem is to have a loading vehicle also in the form of a hover craft which would be confined to operating between warehouses and despatch area. A limited height mast only would be required for fine adjustment and the main elevation would be by means of the thrust unit.

The internal truck cannot follow the same pattern as the despatch unit because of the wind factor but, perhaps, it will be on the following lines:

The conventional channel mast will disappear and be replaced by a chain-like construction which, as it elevates, locks rigid. Traction will be by hydraulic drive to each of four wheels which all swivel. This will enable the truck to drive along a gangway, rotate on the axis of the wheels and service a stack. The common form of power supply will, no doubt, ultimately be nuclear.

For handling steel pallets, the forks will be replaced by a backplate incorporating electromagnets. The conventional forks will slip into this back plate when required.

**Special purpose fork lift trucks**

Having dealt with the fork lift truck operating under more conventional conditions, we should give some consideration to those which we foresee will be required for special duties.

Passing, as we are, into a nuclear future, many applications will arise for remote controlled trucks to operate under conditions which would not be safe for the human being.

For repetitive duties, a punch card system of control could be installed but, for versatility, a radio-controlled truck with television cameras as the viewing eyes will probably be used. The controller will be remote from the danger area and have complete control from a battery of receiving monitors.

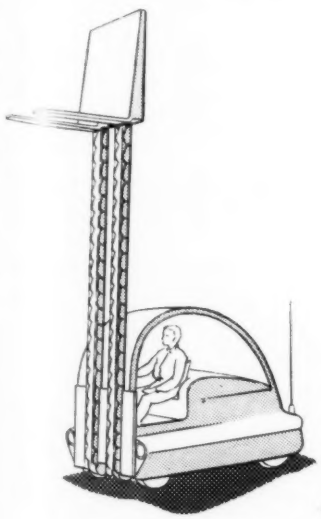


*Fig. 5. Future fork lift truck*

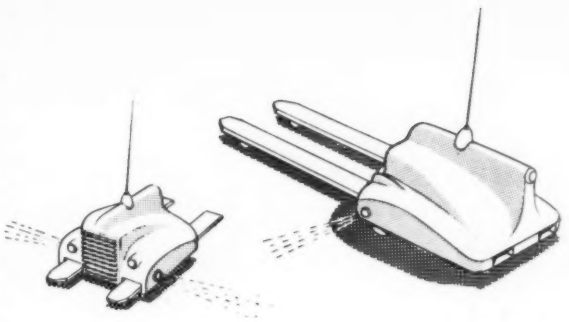


*Fig. 6. Future pallet truck*

Special attachments will be sited at pick-up stations, all of which will be attached to the truck by the controller. The backplate of the truck will automatically engage or disengage the attachment, either by electromagnets or, perhaps, locking tapers.

**Powered pallet trucks of the future**

The remote controlled pallet truck is now on the doorstep of industry and will come into the factory as an automatically controlled unit which, after receiving from the controller a radio signal to proceed to a selected station, will do so by travelling along gangways beamed by overhead wires until disconnected by the selected station's wavelength.

Overhead signalling equipment would give more flexibility than magnetic flooring or inlaid wiring.

Pallet entry will be controlled by the truck brain by means of midget television cameras feeding back to the controls the exact position of pallet entry.

Proximity meters on the truck will give warning of obstacles and bring the truck to a smooth halt to avoid collisions. Retractable forks are envisaged for ease of entry and stability when travelling unladen.

During the pick-up operation, the forks will extend to the required length and prop wheels will lower and raise the pallet for transportation. The main wheels will be individually hydraulically driven from a nuclear power supply. Provision will be made for manual operations when necessary.

**Other Trucks of the future**

Similar controlled units to the previously mentioned will be employed as tractors or tug units for feeding materials and conveying goods to warehouses.

**Conclusion**

We have followed the evolution of the industrial truck, with justified emphasis on the fork lift truck, to its present state and then gazed into the immediate future. But, before concluding this paper, can we leave machine designers with this thought:

A machine is usually classified as a 'static' piece of equipment but it has to be moved several times during its life: (*a*), within the manufacturing factory; (*b*), to the using factory and; (*c*), within the using factory, both at initial installation and any subsequent re-layout or overhaul.

The fork lift truck is now common to most factories. Castings and sub-assemblies can be designed to have fork clearances in addition to lifting eyes for jib attachment use. Also large cylinders can incorporate provision for safe slinging. This aspect would bear immediate closer investigations.

# NAMES AND ADDRESSES OF EXHIBITORS

*This list gives details of the names and addresses, telephone numbers and telegraphic addresses of the exhibitors at the last Mechanical Handling Exhibition. It is reprinted from our May issue, in response to many requests, because the issue was completely sold out within a few days of publication. This list is published as a sequence to the Classified Guide to Manufacturers Products reprinted in our July issue from the Exhibition Catalogue.*

*It is emphasized that both the list below and the guide in the July issue refer only to manufacturers at the Exhibition, and do not cover all manufacturers of mechanical handling equipment.*

| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| **A** | | |
| Abisch Conveyor & Furnace Co., Ltd., 194-196 Finchley Road, London, N.W.3 | Swiss Cottage 3353-4-5 | Abconvey, Haver |
| Access Equipment, Ltd., Maylands Avenue, Hemel Hempstead, Herts | Boxmoor 5781 | Accesequip, Hemelhempstead |
| Accles & Pollock, Ltd., Oldbury, Birmingham | Broadwell 1500 | Accles, Oldbury, Telex |
| Acrow (Engineers), Ltd., South Wharf, Paddington, London, W.2 | Ambassador 3456 | Acrowlit, Padd., London |
| Adrema, Ltd., 2-10 Telford Way, London, W.3 | Shepherds Bush 2091 | Adremalt, Wesphone, London |
| Allam, E. P., & Co., Ltd., 132-135 Sloane Street, Westminster, S.W.1 | Sloane 9976 | Epaltrical |
| Allspeeds, Ltd., Oakenshaw Works, Clayton-le-Moors, Accrington, Lancs | Accrington 5441 | Variator, Accrington |
| Anderston Clyde Engineers, Ltd., Irk Vale Works, Haigh Lane, Chadderton, Lancs | Oldham Main 7871-2 | Colossus, Oldham |
| Angel Truck Co., Ltd., The, 242-244 Billet Road, Walthamstow, London, E.17 | Larkswood 5566 | Angeltruc, London, E.17 |
| Antifyre, Ltd., Shaftesbury Road Works, Acton, W.3 | Acorn 1166-7 | Selantifyr, Wesphone |
| Associated Electrical Industries, Ltd., Rugby, Warwickshire | Rugby 2121 | Assocelect, Rugby, Telex |
| Associations Group Stand: | | |
| Aerial Ropeways Association | Abbey 4961 | Crusades, Sowest, London |
| Association of Crane Makers | Holborn 2662 | — |
| Association of Lifting Tackle Makers | Birmingham Midland 5021 | — |
| British Industrial Truck Association | Abbey 7226 | Crusades, Sowest, London |
| Mechanical Handling Engineers' Association | Abbey 4961 | Crusades, Sowest, London |
| Autoset (Production), Ltd., Stour Street, Birmingham 18 | Edgbaston 1143-4 | Edgbaston 1143 |
| **B** | | |
| B.T.R. Industries, Ltd., Herga House, Vincent Square, S.W.1 | Victoria 3848 | Britgoods, Telex, London |
| Babcock & Wilcox, Ltd., Babcock House, 209 Euston Road, N.W.1 | Euston 4321 | Babcock, London, Telex |
| Bagshawe & Co., Ltd., Dunstable Works, Dunstable, Beds | Dunstable 300-1-2 | Bagshawe, Dunstable |
| Baldwin Industrial Controls, Dartford, Kent | Dartford 26411 | Baldwin, Dartford |
| Barron, W. S., & Son, Ltd., Bristol Road, Gloucester | Gloucester 21055-6-7 | Barron, Gloucester |
| Barrow, Hepburn & Gale, Ltd., Church Road, Mitcham, Surrey | Mitcham 5121 | Belting, Mitcham |
| Becker Equipment & Lifts, Ltd., Twin-Lift Works, Alperton, Wembley, Middx | Wembley 4454 | — |
| Bennis Combustion, Ltd., Little Hulton, Walkden, Manchester | Walkden 3213 | Bennis, Phone, Little Hulton |
| Boydell, E., & Co., Ltd., Elsinore Road, Old Trafford, Manchester 16 | Trafford Park 1641 | Muirhil, Manchester 16 |
| Bray Construction Equipment, Ltd., Faggs Road, Feltham, Middx | Feltham 3471-4 | Braydozer, Feltham |
| British Electrical Repairs, Ltd., Empire House, 10 Charlotte Street, Manchester 1 | Manchester Central 1378 | Manchester Central 1378 |
| British Ermeto Corporation, Ltd., Beacon Works, Hargrave Road, Maidenhead | Maidenhead 5100-9 | Grambon, Maidenhead |
| British Hoist & Crane, Co. Ltd., Compton (Newbury), Berks | Compton 234 | Brithoist, Compton, Newbury |
| British Metal Crates, Ltd., Coronation Street, Stockport | Stockport 3786 | Metalkrate, Stockport |
| British MonoRail, Ltd., Wakefield Road, Brighouse, Yorks | Brighouse 2244 | Monorail, Brighouse |
| British Nylon Spinners, Ltd., 68 Knightsbridge, S.W.1 | Kensington 6333 | Nylon, London, Telex |
| British Ropeways Engineering Co., Ltd., Plantation House, Mincing Lane, E.C.3 | Mincing Lane 7901 | Boxhauling, Fen, London |
| British Wedge Wire Co., Ltd., The, Elmswood, Bounds Green Road, New Southgate, N.11 | Bowes Park 8442 | Modmec, N.11 |
| Brockhouse Engineering, Ltd., Victoria Works, Hill Top, West Bromwich | Wednesbury 0243 | Brockhouse, West Bromwich |
| Brookhirst Igranic, Ltd., Igranic Works, Bedford | Bedford 66261 | — |
| Brown, David, Industries, Ltd., Park Works, Huddersfield | Huddersfield 3500 | Gearing, Huddersfield |
| Brush Electrical Engineering Co., Ltd., Falcon Works, Loughborough, Leics (Battery Electric Vehicle Dept.) | Loughborough 3131 | Brush, Loughborough, Telex |
| Burnand, W. E., & Son, Ltd., Duo Works, 66-106 Shoreham Street, Sheffield 1 | Sheffield 24148 | W. E. Burnand & Son, Ltd., Sheffield |
| Butter Bros. & Co., Ltd., 'The Crane Works', Long Lane, Hillingdon, Middx | Uxbridge 2288 | Buta Cranes |

| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| **C** | | |
| C.A.V. Ltd., Warple Way, Acton, London, W.3 | Shepherds Bush 3111 | Vanteria, Telex, London |
| C.P.C. (Southampton), Ltd., Tanners Street, Tanners Hill, Southampton | Southampton 76305-6-7-8 | Ceepeecee, Southampton |
| Callow, F. E. (Engineers), Ltd., Birchill Road, Kirkby Industrial Estate, nr. Liverpool | Simonswood 2461-2-3 | Fecallow, Liverpool |
| Cargo Transport (Great Britain), Ltd., Bordesley Works, Birmingham 12 | Birmingham Victoria 2371 | Cargonco |
| Carter Gears, Ltd., Thornbury, Bradford | Bradford 64378 | Became, Bdf., Telex |
| Cary, William E., Ltd., Red Bank, Manchester 4 | Deansgate 7881 | Cary, Bank, Manchester |
| Caterpillar Tractor Co., Ltd., P.O. Box No. 162, Glasgow | Uddingston 2921 | — |
| Chain Ltd., Tower House, 40 Trinity Square, London, E.C.3 | Royal 9111 | — |
| Chance P. C. & C. K., Ltd., Portsmouth Road, Cobham, Surrey | Cobham 35 | — |
| Chloride Batteries, Ltd., Exide Works, Clifton Junction, Swinton, Manchester | Swinton 2011 | Chlorexide, Manchester |
| Cohen, George, Sons & Co., Ltd., Wood Lane, London, W.12 | Shepherds Bush 2070 | Omniplant, Telex, London |
| Collins & Sons, Ltd., Regent Square, Gray's Inn Road, W.C.1 | Terminus 6141-2 | Imbercio, Kingcross, London |
| Compressed Rubber Products, Ltd., Bell Works, Harefield, Middx | Harefield 2123-5 | Harebell, Harefield, Middx |
| Conveyancer Fork Trucks, Ltd., Liverpool Road, Warrington, Lancs | Warrington 35241 | Hydraulics, Warrington |
| Conveyors (Readybuilt), Ltd., Cainscross Works, Stroud, Glos | Stroud 1604 | Redler Stroud & Arr Bee Stroud |
| Corbett, R. H., & Co., Ltd., Frindsbury Works, Rochester, Kent | Stroud 78421 | Woodfield, Telex, Rochester |
| Cordey Thomson, 64 Glenhurst Avenue, Bexley, Kent | Crayford 23100 | — |
| Cort, Robert, & Son, Ltd., Reading Bridge Iron Works, Reading | Reading 55056 | Corts, Reading |
| Coventry Climax Engines, Ltd., Widdrington Road, Coventry | Coventry 21424 | Climax, Coventry |
| Crofts (Engineers), Ltd., Thornbury, Bradford 3, Yorks | Bradford 65251 | Crofters, Bradford, Telex |
| Crone & Taylor (Engineering), Ltd., Sutton Oak, St. Helens, Lancs | St. Helens 3283-4-5 | Crontaylor, St. Helens |
| Cutler Conveyor Co., Low Town, Oldbury, nr. Birmingham | Broadwell 2192 | — |
| **D** | | |
| D.P. Battery Co., Ltd., Bakewell, Derbyshire | Bakewell 581-5 | Battery, Bakewell |
| Dallow Lambert Co., Ltd., Thurmaston, Leicester | Syston 3333 | Dust, Leicester |
| Dargue Brothers, Ltd., New Simplon Works, South Parade, Halifax | Halifax 3218-9 | Simplon, Halifax |
| Denison, Saml., & Son, Ltd., Hunslet Foundry, Leeds 10 | Leeds 75488 | Weigh, Leeds 10 |
| Dexion, Ltd., Maygrove Road, Kilburn, N.W.6 | Maida Vale 6031 | Dexion, Kilb., London |
| Diac, Ltd., New Addington, Croydon, Surrey | Lodge Hill 3232 | Kurtag, Croydon |
| Dialled Despatches, Ltd., The Green, Gosport, Hampshire | Gosport 80221-5 | Nicholsons, Gosport |
| Didsbury Engineering Co., Ltd., Little Western Street, Rusholme, Manchester 14 | Rusholme 1495-6-7 | Minilift, Manchester 14 |
| Doity Cranes, Ltd., 24 Brazennose Street, Manchester 2 | Whitworth 3195 | Doity, Manchester |
| Douglas Equipment, Ltd., Kingsditch Lane, Tewkesbury Road, Cheltenham | Cheltenham 56361 | Douglas, Cheltenham |
| Dowty Hydraulic Units, Ltd., Ashchurch, Tewkesbury, Glos | Tewkesbury 2271 | Dowty, Ashchurch, Telex |
| Dowty Seals, Ltd., Ashchurch, Glos | Tewkesbury 2271 | Dowty, Ashchurch, Telex |
| Drag Scraper & Conveyor Co., Ltd., Regis House, King William Street, E.C.4 | Mansion House 6125 | Deesscee, Cent, London |
| Dunlop Rubber Co., Ltd., The, Belting Division, Speke, Liverpool 24 | Hunts Cross 1850 | Duncospeke |
| **E** | | |
| E.M.S. Electrical Products, Ltd., Common Lane, Kenilworth, Warwickshire | Kenilworth 658 & 892 | — |
| Eccles (Birmingham), Ltd., Off Arrow Road, Redditch, Worcs | Redditch 3365-6-7 | — |
| Electro-Hydraulics, Ltd., Liverpool Road, Warrington, Lancs | Warrington 35241 | Hydraulics, Warrington |
| Electromagnets, Ltd., Bond Street, Birmingham 19 | Birmingham Central 5391-2-3 | Boxmag, Birmingham |
| Electropower Gears, Ltd., Kingsbury Works, Kingsbury Road, N.W.9 | Colindale 4621 | Lektropowa, Hyde, London |
| English Electric Co., Ltd., The, Queen's House, Kingsway, W.C.2 | Covent Garden 1234 | Enelectico, Estrand, London |
| Epco, Ltd., Star Works, Skinner Lane, Leeds 7 | Leeds 27471 | Epco, Leeds |
| Ewart Chainbelt Co., Ltd., Colombo Street, Derby | Derby 45451 | Chainbelt, Derby |
| **F** | | |
| F'Ag Bearing Co., Ltd., Macrome Road, Green Lane, Tetten Hall, Wolverhampton | Wolverhampton 52075 | Kages, Telex, Auto 33-214 |
| Felbon Gordon, & Co., Ltd., Spirella House, Oxford Circus, London, W.1 | Regent 3605 | Jcrog, Phone, London |
| Felco Hoists, Ltd., 29 Cromwell Road, South Kensington, S.W.7 | Kensington 7401 | Felcohoist, Westphone, London |
| Finspan Engineering Co., Ltd., Houghton Street, West Bromwich, Staffs | West Bromwich 2827 | — |
| Fisher & Ludlow, Ltd., Material Handling Division, Bordesley Works, Birmingham 12 | Birmingham Victoria 2371 | Flowline, Birmingham |
| Flexello Castors & Wheels, Ltd., Slough, Bucks | Slough 24121 | Flexello, Slough |

| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| Floataire, Ltd., Joseph Street, Leicester | Leicester 23426-7 | Floataire, Leicester |
| Fluidrive Engineering Co., Ltd., Fluidrive Works, Isleworth, Middx | Isleworth 1121 | Hydynamic, Isleworth |
| Ford Motor Co., Ltd., Dept. D.4, Tractor Division, Dagenham, Essex | Dominion 3000 | Fordmotor, Dagenham, Telex |
| Ford Motor Co., Ltd., Parts Division, Aveley Depot, South Ockendon, Romford, Essex | South Ockendon 3434 | Fordparts, Romford, Tele |
| Fourways (Engineers), Ltd., Hemnall Street, Epping, Essex | Epping 2251-2 | Fel, Epping |
| Fyson, C. J. R., & Son, Soham, Cambs | Soham 249 | Fyson, Soham |
| **G** | | |
| Gandy, Ltd., Wheatland Works, Wheatland Lane, Wallasey | Wallasey 9574 | Gandy, Birkenhead |
| Gardiner's Conveyors, Ltd., 16 Lafone Street, Bermondsey, S.E.1 | Hop 3012-3-4 | Carririte, Sedist, London |
| Gascoigne, Geo. H., Ltd., Berkeley Avenue, Reading | Reading 54417 | Kee Klamps, Reading |
| Geest Industries, Ltd., White House Chambers, Spalding, Lincs | Spalding 2326 | Geest, Telex, Spalding 32 |
| Gimson & Co. (Leicester), Ltd., Vulcan Road, Leicester | Leicester 27272 | Gimson, Leicester |
| Glenaldie Engineering Co., Ltd., Great Haseley, Oxford | Great Milton 10 | Glenaldie, Great Milton |
| Glover, J., & Sons, Ltd., Groton Road, Earlsfield, S.W.18 | Vandyke 7755 | Stormor, Westphone, London |
| Godfrey, Sir George, & Partners (Industrial), Ltd., Hampton Road West, Hanworth, Middx | Feltham 3291 | Godfrepart, London |
| Goodyear Tyre & Rubber Co. (Gt. Britain), Ltd., The, Wolverhampton | Wolverhampton 22321 | Gotyruco, Wolverhampton |
| G.P.O. London Telecommunications Region, Waterloo Bridge House, Waterloo Road, S.E.1 | City 2000, Extn. 7074/7492 | — |
| Grading Machinery, Ltd., 46 High Road, Wormley, Herts | Hoddesdon 2377 & 3468 | — |
| Grafton Cranes, Ltd., Vulcan Works, Bedford | Bedford 2490 | Grafton, Bedford |
| Guest, Keen & Nettlefolds (Midlands), Ltd., Box 24, Heath Street, Birmingham 18 (Screw Division) | Smethwick 1441 | Nettlefolds, Birmingham |
| Bolt and Nut Division, Atlas Works, Darlaston | James Bridge 3100 | Cotterills, Darlaston |
| **H** | | |
| Hamworthy Engineering, Ltd., Poole, Dorset | Poole 2020 | Hydraulics, Poole |
| Helicoid Flight Conveyors, Ltd., Deva Works, Saltney, Chester | Chester 23434-7 | Rustproof, Chester |
| Highfield Gear and Engineering Co., Ltd., Karrier Works, Huddersfield | Huddersfield 4490-1-2 | Higears, Huddersfield |
| Holland Cranes, 338 Grand Buildings, Trafalgar Square, London, W.C.2 | Whitehall 4272 | — |
| Holroyd, John, & Co., Ltd., Milnrow, nr. Rochdale, Lancs | Milnrow 55322 | Holroyds, Milnrow, Telex |
| Hunter, G. (London), Ltd., 80 Fenchurch Street, London, E.C.3 | Royal 5522 | Hunter, Fen, London |
| Hydraulics & Pneumatics, Ltd., Wulfruna Works, Villiers Street, Wolverhampton, Staffs | Wolverhampton 24456 | Wulfruna, Wolverhampton |
| **I** | | |
| I.T.D., Ltd., Webb Lane, Hall Green, Birmingham 28 | Springfield 2282 | Elecomcar, Birmingham |
| Industrial & Commercial Finance Corporation, Ltd., 7 Draper's Gardens, London, E.C.2 | National 8621 | Incof, Stock, London |
| Industrial Machine & Equipment Co. (Brimpex), Ltd., Brimpex Works, Yorktown Industrial Estate, Camberley, Surrey | Camberley 2688 | Brimpex, Camberley, Surrey |
| Institute of Materials Handling, The, 32 Watling Street, London, E.C.4 | City 7045 | — |
| International Combustion Products, Ltd., 19 Woburn Place, London, W.C.1 | Terminus 2833 | Lopulco, Westcent, London |
| Ionic Plating Co., Ltd., Ionic Works, Grove Street, Birmingham 18 | Smethwick 1876 | Ionic, Birmingham |
| Irwin, E. G., & Partners, Ltd., 2 Princes Row, Buckingham Palace Road, S.W.1 | Tate Gallery 9393 | Trigmetric, Sowest, London |
| **J** | | |
| Jewbury's Mechanical Handling, Ltd., Chapel Street, Manchester 3 | Deansgate 4411-2-3 | Powerants, Manchester |
| Johnson, C. H. (Machinery), Ltd., Adswood, Stockport, Cheshire | Stockport 2642-3 | Machinery, Stockport |
| **K** | | |
| Keelavite Hydraulics, Ltd., Allesley, Coventry | Meriden 441 | Keelavite, Coventry |
| Kenyon, Wm., & Sons, Ltd., Chapel Fields Works, Dukinfield, Cheshire | Ashton-under-Lyne 1614 | Kenyon, Dukinfield |
| Kimbell Machine Tools, Ltd., 4 South Lambeth Place, Vauxhall, S.W.8 | Reliance 6711 | Jonkimbell, London, Telex |
| King, Geo. W., Ltd., Argyle Works, Stevenage, Herts | Stevenage 440 | Konveyas, Stevenage, Telex 82151 |
| Krausskopf Verlag, Bahnhofstrasse 61, Wiesbaden, Germany | — | — |

| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| **L** | | |
| Lampeter Timber & Trading Co., Ltd., Millfield Works, Lampeter, Cards | Lampeter 293-4 | — |
| Lan[illegible]n Engineering Co., Ltd., Hythe Road, London, N.W.10 | Ladbroke 2424 | Kelywil, Harles, London |
| La[illegible]s Machinery, Ltd., 41 Knightsbridge, S.W.1 | Belgravia 6374 | Sideloader, London |
| La[illegible]Pneumatic, Ltd., Owen Road, Wolverhampton, Staffs | Wolverhampton 25221 | Pneulang, Wolverhampton, Telex 33193 |
| La[illegible]y & Co., Ltd., 14-16 Magdalen Street, London Bridge, S.E.1 | Hop 2217-8 | — |
| La[illegible]e Bagnall, Ltd., Kingsclere Road, Basingstoke, Hants | Basingstoke 1010 | Bagnallic, Basingstoke |
| La[illegible]n (Successors), Ltd., Sentinel Works, Doris Road, Bordesley [illegible]n, Birmingham 9 | Birmingham Victoria 1902-3-4 | Specialities, Birmingham |
| La[illegible]k Engineering, Ltd., Industrial Division, Victoria Works, [illegible]houses, Sheffield 8 | Sheffield 74411 | Invention, Sheffield |
| Le[illegible]ses, Ltd., Maypole House, Finsbury Square, E.C.2 | Monarch 9488 | Leepakstock, London |
| Leg[illegible]Industries), Ltd., Williamson Street, Wolverhampton | Wolverhampton 24091-2 | Legrec, Wolverhampton |
| Len[illegible] Engineering Co., Church Road Extension, Thurmaston, Le[illegible]ster | Syston 2749 | — |
| Leve[illegible]n of Leeds, Ltd. (see Fred Myers), Gelderd Road, Gilder-so[illegible] Leeds | Morley 4221 | — |
| Light Alloy Construction, Ltd., Mowden Hall, Darlington, Co. Du[illegible]am | Darlington 5226 | Summit, Telex 58512 |
| Lloyds Bank, Ltd., 71 Lombard Street, E.C.3 | Mansion House 1500 | Branchage, Stock, London |
| Locke Industries, Ltd., Church Street, Warrington, Lancs | Warrington 34111-6 | Lockers, Warrington |
| Lodematic, Ltd., Clitheroe, Lancs | Clitheroe 209, 1080 & 51 | Lodematic, Clitheroe |
| Lucas, Joseph (Hydraulic & Combustion Equipment), Ltd., The Radleys, Marston Green, Birmingham 33 | Marston Green 2281 | Luset, Birmingham |
| **M** | | |
| M.G.K. Engineering Co., Ltd., Gazette Building, Corporation Street, Birmingham 4 | Birmingham Central 2517 | Katelbee, Birmingham |
| Mann, Albert, Engineering Co., Ltd., Basildon Industrial Estate, Essex | Basildon 20421 | Ameco, Basildon |
| Mann (Handling), Ltd., Bathville Steel Works, Armadale, West Lothian | Armadale 402-3 | Mann, Armadale, West Lothian |
| Manufacturers Equipment Co., Ltd., Sutton Road, Hull, Yorks | Hull 13996 | Rapistan, Hull |
| Marcar, Alexander, & Co., Ltd., 61 Pall Mall, London, S.W.1 | Whitehall 8586 | Marcasteel, Piccy, London, Telex GBLN 28128 |
| Marshall, A. L. (Carlton), Ltd., Cemetery Road, Carlton, Nottingham | Nottingham 24-6231 | Marshall, Phone, Nottm. 24-6231 |
| Martonair, Ltd., Parkshot, Richmond, Surrey | Richmond 2201 | Martonair, Richmond, Surrey, Telex |
| Massey-Ferguson (Gt. Britain), Ltd., Fletchamstead, Highway, Coventry | Tile Hill 65211 | Masferg, Coventry |
| Matbro, Ltd., Matbro Works, Horley, Surrey | Horley 4441-5 | Matbro, Horley |
| Materials Handling Equipment (Gt. Britain), Ltd., Church House, Maidenhead, Berks | Maidenhead 5160 | Matanec, Maidenhead, Berks |
| Matling, Ltd., Park Lane, Fallings Park, Wolverhampton | Wolverhampton 31295 | Matling, Wolverhampton |
| Matterson, Ltd., P.O. Box 31, Shawclough, Rochdale, Lancs | Rochdale 49321 | Matterson, Rochdale |
| Maxam Power, Ltd., 44 Brook Street, W.1 | Hyde Park 9444 | Airdrill, London |
| MECHANICAL HANDLING, Dorset House, Stamford Street, London, S.E.1 | Waterloo 3333 | Mechand, Sedist, London |
| Mercury Truck & Tractor Co., Ltd., The Quay, Gloucester | Gloucester 24451-2 | Mercury, Gloucester |
| Merrick Scale Mfg. Co., Ltd., Albert Street, Bulwell, Nottingham | Nottingham 27-1458-9 | Merricks, Nottingham |
| Metal Box Co., Ltd., The, 37 Baker Street, London, W.1 | Hunter 5577 | — |
| Metal Products (Arden), Ltd., 65-70 Great King Street, Birmingham | Northern 5195 | — |
| Midland Bank, Ltd., Premises Dept., Poultry, E.C.2 | Monarch 9911 | Midland, Stock, London |
| Mining Engineering Co., Ltd., Meco Works, Bromyard Road, Worcester | Worcester 22291 | Meco, Worcester |
| Mitchell Engineering, Ltd., 1 Bedford Square, London, W.C.1 | Museum 5511 | Micontraco, Westcent |
| Mono Pumps, Ltd., Mono House, 1 Sekforde Street, Clerkenwell Green, E.C.1 | Clerkenwell 8911 | Monopumps, Phone, London |
| Montgomerie Reid Engineering Co., Ltd., Bramley, nr. Basingstoke, Hants | Bramley Green 289 | Emmar, Bramley, Hants |
| Morris, Herbert, Ltd., P.O. Box 7, Loughborough, Leics | Loughborough 3123 | Comorris, Loughborough |
| Morse Chain Division & Hartcliffe Chains Division of Borg-Warner, Ltd., Jubilee Road, Letchworth, Herts | Letchworth 2170 | Borgwarner, Letchworth |
| Mosgear Co., Ltd., The, Crown Works, Tyburn, Birmingham 24 | Erdington 1661-6 | Mosgear, Birmingham |
| Mucon Engineering Co., Ltd., Stonefield Way, South Ruislip, Middx | Byron 7261-2-3 | Mucon, Ruislip |
| Murphy Radio, Ltd., Electronics Division, Welwyn Garden City, Herts | Welwyn Garden 3434 | Murphy, Welwyn Garden City, Telex |
| Myers, Fred., Ltd., 24 Burton Street, Berkeley Square, W.1 | Hyde Park 6911 | Myerstrac, London |
| **N** | | |
| Neal, R. H., & Co., Ltd., Plant House, Longfield Avenue, Ealing, W.5 | Ealing 3171 | Snoslaen, Ealux, London |

| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| Neco Geared Motors, Ltd., 204 Queenstown Road, London, S.W.8 | Macaulay 3211-4 | Neconditi, Clapcom, London |
| Nife Batteries, Union Street, Redditch, Worcs | Redditch 157 | Batteries, Redditch |
| Normand Electrical Co., Ltd., North Street, Clapham Common, S.W.4 | Macaulay 3211-4 | Neconditi, Clapcom, London |
| Northern Manufacturing Co., Ltd., Gainsborough, Lincs | Gainsborough 2231 | Gears, Gainsborough |
| Numec, Ltd., New Whittington, Chesterfield | Chesterfield 5707 | Numec, Chesterfield |
| **O** | | |
| Oddy Engineering, Ltd., Victoria Works, Millhouses, Sheffield 8 | Sheffield 74411 | Invention, Sheffield |
| Oldham & Son, Ltd., Denton, Manchester | Denton 2431 | Oldhams, Denton, Manchester |
| Omic, Ltd., 9 George Street, Baker Street, W.1 | Welbeck 3313, 2678, 8981 | Paliton, Wesdo, London |
| Opperman, S. E., Ltd., Boreham Wood, Herts | Elstree 2021 | Gearcut, Borehamwood |
| **P** | | |
| Parsons, S., & Co., Ltd., Young Street, Bradford 8, Yorks | Bradford 45494 | Parweigh, Bradford |
| Paterson Hughes Engineering Co., Ltd., Bedford House, Bedford Street, Strand, W.C.2 | Temple Bar 7274-6 | Zenithlo, Phone, London |
| Penfold Fencing & Engineering, Ltd., Imperial Works, Balmoral Road, Watford, Herts | Watford 21241-3 | Penfold, Watford |
| Perkins Engines, Ltd., Peterscourt, Peterborough, Northants | Peterborough 5341 | Perkoil, Peterborough, Telex |
| Piper, F., & Sons, Ltd., 62-70 Elmington Road, Camberwell, S.E.5 | Rodney 5288 | — |
| Pitt, Charles (Barton Stacey), Ltd., Barton Stacey, Winchester, Hants | Sutton Scotney 251-2 | Pitt, Barton Stacey |
| Plessey Co., Ltd., Kembrey Street, Swindon, Wilts | Swindon 6251 | Plessey, Telex, Swindon |
| Pollard Bearing, Ltd., Ferrybridge, Knottingley, Yorks | Knottingley 2323 | Balbearing, Ferrybridge |
| Powell & Co., Burry Port, Carms., South Wales | Bury Port 284-5 | — |
| Powell Duffryn Engineering Co., Ltd., Cambrian Works, Maindy, Cardiff | Cardiff 29611 | Peedeng, Cardiff |
| Power Jacks, Ltd., Valetta Road, London, W.3 | Shepherds Bush 3443-6 | Newsorber, Ealux, London |
| Pressoturn, Ltd., Leamington Spa, Warwickshire | Leamington Spa 7056-7 | Alucon, Leamington Spa |
| Priestman Bros., Ltd., Hedon Road, Hull | Hull 75111 | Priestman, Hull |
| Promecon Manufacturing Co., Ltd., Thanet House, High Street, Brentford, Middx | Isleworth 6596-6601 | — |
| **R** | | |
| Rack Engineering, Ltd., 408a Montrose Avenue, Trading Estate, Slough, Bucks | Slough 25108 | Racks Slough |
| Ransomes and Rapier, Ltd., P.O. Box 1, Waterside Works, Ipswich | Ipswich 56383 | Sluice, Ipswich, Telex |
| Rapid Magnetic, Ltd., Lombard Street, Birmingham 12 | Birmingham Victoria 1137 | Magnetism, Birmingham |
| Rawlplug Co., Ltd., The, Rawlplug House, Cromwell Road, South Kensington, S.W.7 | Fremantle 8111 | Rawlplug, London, S.W.7 |
| Redler Conveyors, Ltd., Dudbridge Works, Stroud, Glos | Stroud 1604 | Redler, Stroud |
| Rendale Conveyors, Ltd., 5 Great Hampton Street, Birmingham 18 | Birmingham Central 4225-6-7-8-9 | Rendale, Birmingham |
| Renold Chains, Ltd., Renold House, Wythenshawe, Manchester | Mercury 5221 | Driving, Manchester |
| Revol, Ltd., Exchange Building, Quayside, Newcastle-on-Tyne 1 | Newcastle 2-2480 | Revolite |
| Richards Structural Steel Co., Ltd., Phoenix Iron Works, Leicester | Leicester 61237 | Richards, Leicester |
| Richardson Scale Co., Ltd., Albert Street, Bulwell, Nottingham | Nottingham 27-1441-3 | Richscalco, Nottingham |
| Riley (I.C.) Products, Ltd., 19 Woburn Place, London, W.C.1 | Terminus 2833 | Lopulco, Westcent, London |
| Roballo Engineering Co., Ltd., 43 Dover Street, London, W.1 | Hyde Park 0659 | — |
| Robinson, Thomas, & Son, Ltd., Railway Works, Rochdale, Lancs | Rochdale 47811 | Robinson, Rochdale |
| Rolatruc, Ltd., 20 Old Compton Street, London, W.1 | Regent 1509 | Rolatruc, London |
| Ropeways, Ltd., 62 London Wall, London, E.C.2 | National 0124-5 | Ropeways, London |
| Ross Engineers, Ltd., 11 Walpole Street, Surbiton, Surrey | Elmbridge 2345 | Rospatent, Phone, London |
| Rownsons (Conveyors), Ltd., Maiden Lane, York Way, King's Cross, London, N.7 | Gulliver 7721 | Rownson, Cent, London |
| Rubber By-Products (Warwickshire), Ltd., 86 Holloway Road, Birmingham 1 | Birmingham Midland 3475-9 | — |
| Rubery, Owen & Co., Ltd., P.O. Box 10, Darlaston, Wednesbury, S. Staffs | James Bridge 3131 | Ruberowen, Telex, Darlaston |
| Russell Constructions, Ltd., Russell House, Adam Street, Adelphi, W.C.2 | Temple Bar 0055 | Russelcon, Rand, London |
| **S** | | |
| St. Claire Engineering Co., Ltd., Bridge Road, Lymington, Hants | Lymington 2156 | — |
| Salisbury Precision Engineering, Ltd., Heston Airport, Hounslow, Middx | Hayes 3844 | Hestairco, Hounslow |
| Schrader's, A., Son, Division of Scovill Mfg. Co., 829 Tyburn Road, Erdington, Birmingham 24 | Erdington 2267 | Airvalve, Birmingham |
| Scientific Automation Co., Ltd., 5-7 New York Road, Leeds 2 | Leeds 35401 | Automation, Leeds |
| Scottish Mechanical Light Industries, Ltd., 42-44 Waggon Road, Ayr, Scotland | Ayr 64601 | Scotmec, Ayr |
| Self-Changing Gears, Ltd., Lythalls Lane, Coventry | Coventry 89081 | Self-Change, Coventry |

| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| Service Engineering Co. (Northampton), Ltd., Weedon Road, Industrial Estate, Northampton | Northampton 2631 | Semac, Northampton |
| Sharp Control Gear, Ltd., Lount Works, Ashby-de-la-Zouch | Ashby 422-3 | Makitsharp, Ashby-de-la-Zouch |
| Shaw J. E., Ltd., Kingsclere Road, Basingstoke, Hants | Basingstoke 1100 | — |
| Sheepbridge Equipment, Ltd., Sheepbridge Works, Chesterfield, Derbys | Chesterfield 5471 | Sheepbridge, Chesterfield |
| Sheldrake & Drewry, Ltd., Letchworth, Herts | Letchworth 234 | Sheldry, Letchworth |
| Silvertown Rubber Co., Ltd., Herga House, Vincent Square, S.W.1 | Victoria 8323 | Silvergray, Telex, London |
| Simon Handling Engineers, Ltd., Cheadle Heath, Stockport | Gatley 3621 | S.H.E.L., Telex, Stockport |
| Slingsby, H. C., Ltd., 89, 95-97 Kingsway, W.C.2 | Holborn 2551 | Truckman, Westcent, London |
| Smith R. (Horley), Ltd., 41 Balcombe Road, Horley, Surrey | Horley 3882 | — |
| Smith S., & Sons (England), Ltd., Cricklewood, London, N.W.2 | Gladstone 3333 | Speedofac, London, Telex |
| Smith Thomas, & Sons (Rodley), Ltd., Crane & Excavator Works, Rodley, Leeds | Pudsey 2844 | Smith, Rodley |
| Spencborough Engineering Co., Ltd., Union Road, Heckmondwike, Yorks | Heckmondwike 924 | Union, Heckmondwike |
| Spencer (Melksham), Ltd., Beanacre Road, Melksham, Wilts | Melksham 2251 | Spencer, Melksham |
| Stanhay (Ashford), Ltd., Elwick Works, Ashford, Kent | Ashford, Kent 1170 | Stanhay, Ashford |
| Steele G., & Co., Ltd., 93 West George Street, Glasgow, C.2 | Glasgow Central 0934-5 | Mountings, Glasgow, C.2 |
| Steels Engineering Products, Ltd., Crown Works, Sunderland | Sunderland 56281 | Steel, Sunderland |
| Stein Atkinson Vickers Hydraulics, Ltd., 197 Knightsbridge, London, S.W.7 | Knightsbridge 9641 | Hydraulics, London, S.W.7 |
| Stephens Belting Co., Ltd., Snow Hill, Birmingham 4 | Birmingham Central 4841 | Mirabelt, Birmingham 4 |
| Stephens, E., & Son, Ltd., 58-66 Bath Street, London, E.C.1 | Clerkenwell 1731 | — |
| Stewart Gill & Co., Ltd., Wellcroft Road, Slough, Bucks | Slough 20874 & 21173 | — |
| Stott, S. S., Ltd., Haslingden, Rossendale, Lancs | Rossendale 666 | Elevator, Haslingden |
| Strachan & Henshaw, Ltd., Steelhoist Works, Victoria Road, St. Philips, Bristol 2 | Bristol 78331 | Stelhoist, Bristol |
| Strappings, Ltd., Gordian House, Aintree Road, Perivale, Greenford, Middx | Alperton 2333-7 | Hiten, Greenford |
| Super Oil Seals & Gaskets, Ltd., Birmingham Factory Centre, King's Norton, Birmingham 30 | King's Norton 2041 | Oilseal, Birmingham |
| Superbuilt Products, Ltd., Bell Works, Harefield, Middx | Harefield 2123-5 | Harebell, Harefield |
| Sutcliffe, Richard, Ltd., Universal Works, Horbury, Wakefield, Yorks | Horbury 350 | Sutcliffe, Horbury |
| **T** | | |
| T. & T. Works, Ltd., and Modern Plant Autoloaders, Billesdon, Leicester | Billesdon 261 | Conveyor, Leicester |
| Taylor, F., & Sons (Manchester), Ltd., 142 Bolton Road, Pendleton, Salford 6, Lancs | Pendleton 1341 | Efftayson, Salford 6 |
| Technivision, Ltd., Braywick House, nr. Maidenhead, Berks | Maidenhead 5163 | — |
| Teleflex Products, Ltd., Basildon, Essex | Basildon 20581 | Teleflex, Phone, Basildon |
| Thames Packaging Equipment, Ltd., The, 28 City Road, London, E.C.1 | Monarch 7387-8 | Pakitup, Cent, London |
| Thomas, Bertram (Engrs.), Ltd., 28 Victoria Street, London, S.W.1 | Abbey 2737 | Dylectromo, London |
| Tilgate Sawmills, Ltd., Brighton Road, Crawley, Sussex | Crawley 25751 | — |
| Tirfor, Ltd., 27 Broomgrove Road, Sheffield 10 | Sheffield 64436 | Machinery, Sheffield 10 |
| Tower Cranes, Ltd., 39 Victoria Street, London, S.W.1 | Abbey 6806 | Towcranes, Sowest, London |
| Tubewrights, Ltd., Kirkby Industrial Estate, Liverpool | Simonswood 2882 | — |
| Tuglift, Ltd., Scotts Green, Dudley, Worcs | Dudley 54311 | Trucks, Dudley |
| Tunny Cranes, Ltd., Abbey House, 2 Victoria Street, London, S.W.1 | Abbey 6866 | Tunnicrane, London |
| Turner Bros. Asbestos Co., Ltd., Rochdale, Lancs | Rochdale 4221 | Turners, Rochdale, Telex 63-174 |
| **U** | | |
| United Dominions Trust Commercial, Ltd., The, United Dominions House, Eastcheap, E.C.3 | Mincing Lane 3020 | Banquithus, Telex, London |
| Universal Conveyor Co., Ltd., Barkby Road, Leicester | Leicester 67822 | — |
| **V** | | |
| V.M.E. Conveyor & Furnace Co., Ltd., 1026-28 Harrow Road, London, N.W.10 | Ladbroke 0259 | — |
| Vac-Lift (Great Britain), Ltd., 34 West George Street, Glasgow C.2 | Douglas 2144 | Vaculift, Glasgow |
| Varatio-Strateline Gears, Ltd., 277-279 Aberdeen Avenue, Trading Estate, Slough | Slough 20271-2 | Varatio, Slough |
| **W** | | |
| Ward, Thos. W., Ltd., Albion Works, Sheffield | Sheffield 26311 | Forward, Sheffield |
| Weatherill, F. E., Ltd., Tewin Road, Welwyn Garden City, Herts | Welwyn Garden 4221 | Weatherhyd, Welwyn Garden City |
| Webb Conveyors & Automation, Ltd., Airport Works, Rochester, Kent | Chatham 44400 | Jerweb, Chatham |
| Wessex Industries (Poole), Ltd., Dolphin Works, West Street, Poole | Poole 2000 | Industries, Poole |

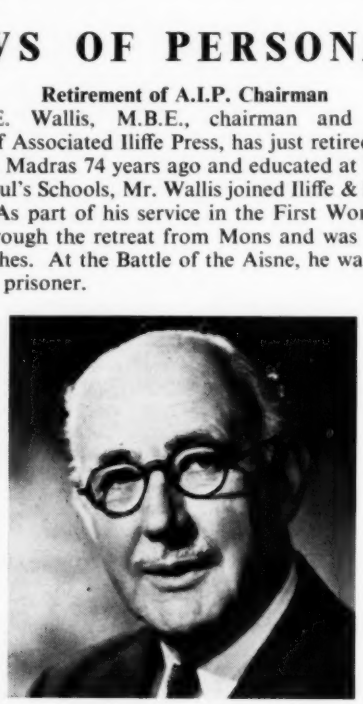
| NAME AND ADDRESS | TELEPHONE NO. | TELEGRAPHIC ADDRESS |
|---|---|---|
| West Dock Timber Co., Ltd., Manchester Street, Hull, E. Yorks | Hull 37738 | Woodcraft, Hull |
| Westinghouse Brake & Signal Co., Ltd., 82 York Way, King's Cross, N.1 | Terminus 6432 | Westinghouse, London, Telex |
| Weston Works (Birmingham), Ltd., Weston Lane, Greet, Birmingham 11 | Acocks Green 3936 | Sunsabod, Birmingham 11 |
| West's Group of Industries, Norton Street, Miles Platting, Manchester 10 | Collyhurst 2961 | Stoker, Manchester 10 |
| Westwood, Dawes & Co., Ltd., Bowling Green Road, Stourbridge, Worcs | Stourbridge 4741-4 | Westwood, Dawes, Stourbridge |
| Wharton Engineers (Elstree), Ltd., Watford Road, Elstree | Elstree 2205 | Experimental, Elstree |
| Wheway, Watson & McLean, Ltd., Green Lane, Walsall, Staffs | Walsall 3171 | Wheway, Walsall |
| White Child & Beney, Ltd., Shepley Works, Audenshaw, nr. Manchester | Denton 4248 | Slivcans, Manchester |
| Willmot Trucks, Ltd., Scotts Green, Dudley, Worcs | Dudley 54311 | Trucks, Dudley |
| Winget, Ltd., Rochester, Kent | Strood 7276 | Wingetism, Rochester |
| Wingrove & Rogers, Ltd., Acornfield Road, Kirkby, Industrial Estate, nr. Liverpool | Simonswood 2631 | Components, Liverpool 1 |
| Wiseman, Alfred, & Co., Ltd., Glover Street, Birmingham 9 | Birmingham Victoria 2216-9 | Verus, Phone, Birmingham |
| Witlor, Ltd., 107-109 Lancaster Street, Birmingham 4 | Aston Cross 2865 | Witlor, Birmingham |
| Wood, Hugh, & Co., Ltd., Royal London House, Finsbury Square, E.C.2 | Monarch 3273 | Huwood, Stock, London |
| **Y** | | |
| Yale & Towne Manufacturing Co., Materials Handling Division, Wednesfield, Wolverhampton, Staffs | Willenhall 941 | Yaletowne, Wolverhampton |
| Youngman, W. C., Ltd., Manor Royal, Crawley, Sussex | Crawley 1234 | Youngman, Crawley |
| **Z** | | |
| Zinc Alloy Rust Proofing Co., Ltd., Shakespeare Street, Wolverhampton | Wolverhampton 27531 | Zincproof, Wolverhampton |

# NEWS OF PERSONALITIES

### Retirement of A.I.P. Chairman

Claude E. Wallis, M.B.E., chairman and managing director of Associated Iliffe Press, has just retired.

Born in Madras 74 years ago and educated at Emmanuel and St. Paul's Schools, Mr. Wallis joined Iliffe & Sons, Ltd., in 1911. As part of his service in the First World War he fought through the retreat from Mons and was mentioned in despatches. At the Battle of the Aisne, he was wounded and taken prisoner.



*Claude E. Wallis*

After the armistice Mr. Wallis returned to Iliffe and in 1930 was appointed director. In 1938 he was made managing director of the Associated Iliffe Press, Ltd., and chairman and managing director in 1945.

Despite the responsibilities and many activities in which he was involved as the leader of the world's largest publishers of technical and trade journals embracing, some 35 publications, Mr. Wallis took a keen interest in *Mechanical Handling* and was known personally to many friends in the industry. Although he freely admits that he was probably the most difficult person to whom to sell the idea of the Mechanical Handling Exhibition when it was first envisaged in 1948, he gave enthusiastic support to this project and looked upon the exhibition as the opportunity to meet many of the personnel in the industry.

By this means his personality and human understanding gained him many friends, whom we feel will wish him all health and happiness in his retirement and in his newly appointed task as treasurer of the Royal Motor Yacht Club.

Appleby-Frodingham Steel Co., a branch of The United Steel Companies, Ltd., has made the following new appointments: **R. Wogin,** at present manager of the Appleby melting shop, will become assistant works manager (steel). **R. Johnson** is appointed melting shops manager for both the Appleby and Frodingham melting shops. **A. F. Jessop** is appointed manager of the Appleby melting shop and **W. L. Willsher** becomes manager of the Frodingham melting shop.

**J. D. Parkinson,** parts manager of International Harvester since 1955, has been appointed assistant manager of domestic sales. He joins T. F. Butler, recently appointed to the same position, as assistant to H. E. Norris. Succeeding Mr. Parkinson as parts manager is **J. P. O'Shea** and assistant parts manager is **R. G. Baird.**

**General Sir Geoffrey Bourne, K.C.B., K.B.E., C.M.G.,** has been appointed director-general to succeed Air Commodore W. Helmore, C.B.E., who recently retired after 14 years as director-general of The Aluminium Development Association.

(*Continued on page* 563)

*David C. Haney*

*Bernard Wright*

*R. W. Barton*

*George Beebee*

*G. H. Doust*

**Ian West,** who for the past 2½ years has been press and publicity manager of E.M.I. Electronics, Ltd., left on July 1st to take up a new appointment with the Fairbanks Whitney Corporation of New York. After some four weeks touring the plants of Fairbanks Morse & Co., Mr. West will return to London and be based at E.M.I. House, Manchester Square.

BTR Industries, Ltd., announces the appointment of **F. S. Lloyd** as purchasing officer for the BTR Group. For the last five years purchasing officer for the Crompton Parkinson Group of Companies, Mr. Lloyd previously held senior buying appointments with Mullard Equipment, Ltd., and Marconi Instruments, Ltd. He has for many years been active in the Purchasing Officers Association, taking a leading part in that association's work in connection with education for supply management in industry. Mr. Lloyd will operate from the BTR Group headquarters at Herga House, Vincent Square, S.W.1.

W. C. Youngman, Ltd., announce that owing to expansion of their materials handling division, they have recently appointed the following new technical representatives: **J. W. Ridley** is taking over the North London and Home Counties area and has come from the automobile industry where he has specialized for some years in selling to industry. In the Midlands, **S. G. Collins** is now assisting Mr. Adams to look after the expanding business in the Birmingham area.

A new territory comprising Pembrokeshire, Glamorganshire, Carmarthenshire, Monmouthshire, Gloucestershire, Somerset, Devon, Cornwall, Wiltshire, Dorset and Herefordshire has now been created and **Alan Ward**, of Cheltenham, has recently taken over.

**David C. Haney** has been appointed managing director of the International Harvester Co. of Great Britain, Ltd. He succeeds O. C. Voss who recently returned to the United States.

The British Gear Manufacturers' Association recently presented a gold medal to **Arthur Sykes, O.B.E., B.Sc., Wh.Ex., M.I.Mech.E., M.I.P.E., M.S.A.E.** This honour, the first conferred on a B.M.G.A. member, is in recognition of Mr. Sykes's outstanding services to the British gear-manufacturing industry.

*Arthur Sykes*

*Col. P. A. Adams*

**Colonel P. A. Adams, B.A.,** has recently joined, as chief engineer, Ford & Walton, Ltd., the building and civil engineering company of the Chamberlain Group of Companies.

Plessey International, Ltd., announce that **G. H. Doust** has been appointed general manager. Before joining Plessey International in November, 1958, as deputy to the general manager, Mr. Doust was with Plessey Chemical and Metallurgical Division at Towcester, Northants, where he controlled the commercial and sales department.

**F. Eric L. Bache** has resigned as chairman of Geo. Salter & Co., Ltd., who this year celebrate their bi-centenary. Mr. Bache has suffered from ill-health for some months and feels that he can no longer carry on in this capacity.

The new chairman is his nephew, **R. Philip S. Bache,** who has been managing director of the company since 1947 and will continue in this office additionally. Mr. Philip Bache, who is 52 years of age, has been a director of Geo. Salter & Co., Ltd., since 1928.

**Sir James Doak,** who has been associated with Fenner's Indian enterprises for a number of years, has joined the board of J. H. Fenner & Co. (Holdings), Ltd., the Hull firm of mechanical power transmission engineers.

**Bernard Wright** of John Thompson Instrument Co., Ltd., who joined the company in June, 1958, as their London representative, has been promoted to the position of sales manager. Mr. Wright will continue to be based at the company's London office in Kingsway, W.C.2.

Stephens-Adamson Mfg. Co. have appointed **R. W. Barton** as president of the newly formed company in Fribourg, Switzerland, Stephens-Adamson International S.A. Mr. Barton was formerly manager of the Export Department of Stephens-Adamson Mfg. Co.

**George Beebee** has been appointed comptroller of the British Division of Yale & Towne. Mr. Beebee succeeds Mr. Sewell as comptroller.

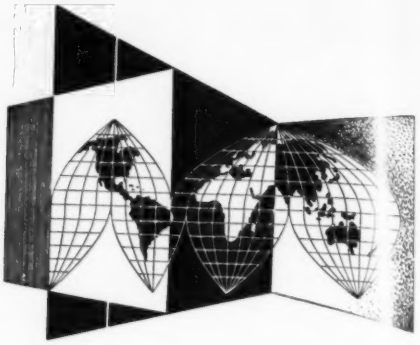
## OBITUARIES

British Insulated Callender's Construction Co., Ltd., announce the death of **C. H. Frankland, M.I.E.E.,** a director of the company from its formation in 1949.

The death is reported of **Irving B. Hexter,** president of The Industrial Publishing Corporation of Cleveland, U.S.A. Mr. Hexter founded the magazine 'Flow', later called 'Material Handling Engineering' in 1945 and had many friends in the British mechanical handling industry.

The Engineering Group of The General Electric Co., Ltd., announce with regret the death of **F. C. Archer** aged 62 years. Mr. Archer joined the Witton Engineering Works of the company in 1937 as assistant superintendent in the Winding Department and was promoted to superintendent in 1946, a position he held until his death.

# BRITISH MECHANICAL HANDLING EQUIPMENT OVERSEAS



*Britische Förder- und Hebegeräte befinden sich in den meisten Ländern der Erde im Einsatz. Seit Kriegsende steigern sich die Verkaufsziffern an ausländische Abnehmer von Jahr zu Jahr. Ein so grosses Ansehen geniessen Geräte britischer Herstellung, dass ausländische Käufer anlässlich der alle zwei Jahre von dieser Zeitschrift in London veranstalteten förder- und hebetechnischen Ausstellungen in Strömen herbeikommen.*

*In dieser monatlich fortgesetzten Artikelserie werden wir kurzgefasste Einzelheiten und Abbildungen britischer Geräte bringen, welche für das Ausland konstruiert bzw. dort bereits im Einsatz sind.*

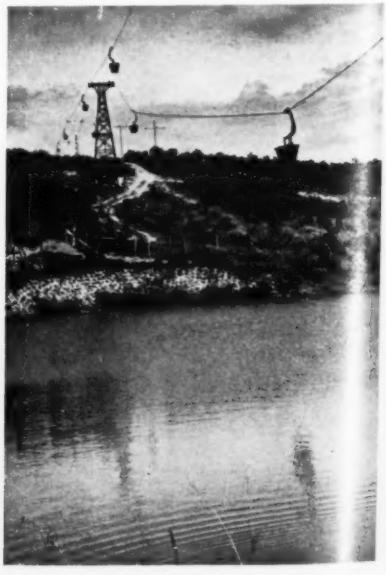
*Ausländische Leser, welche an Auskünften über britische Förder- und Hebegeräte gleichwelcher Art, bzw. an Namen und Adressen der entsprechenden Hersteller, Agenten und Vertreter in irgend einem gegebenen Lande interessiert sind, werden gebeten, sich schriftlich an die Redaktion zu wenden.*

←

**HOLLAND.** The photograph shows a Rapier Super fork truck, stacking a log at Rotterdam.

↓ **SIERRA LEONE.** A crushing and screening plant manufactured by Frederick Parker, Ltd., and owned by the Sierra Leone Development Co., Ltd., is producing about 400 tons per week of crushed granite-type material for use as railway track ballasting in Sierra Leone.

**BRAZIL.** This monocable aerial ropeway is carrying limestone at the rate of 100 tons/hr over a distance of 17¼ miles in Brazil, and is one of many installations by British Ropeway Engineering Co., Ltd., at work throughout South America. ↓



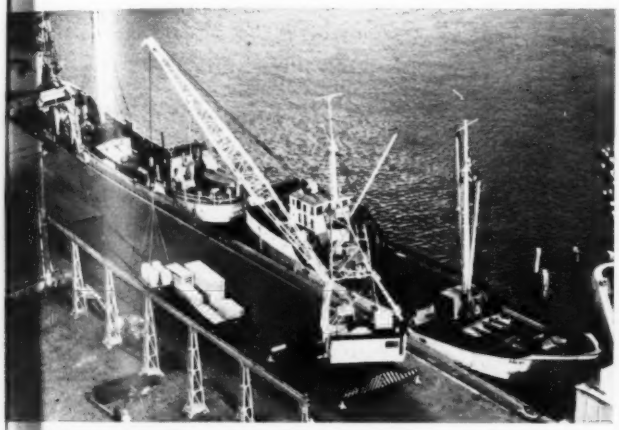
**British mechanical handling equipment is to be found working in most countries of the world. Each year since the end of the war, sales to overseas customers have increased. Buyers from overseas flock to the Mechanical Handling Exhibitions (organized by this journal) held every two years in London, so great is the regard for British-made equipment.**

**In this feature, to be continued each month, we shall bring you brief details and illustrations of such British equipment designed for, or at work in, countries abroad.**

**Overseas readers requiring information on any type of British mechanical handling equipment, or names of manufacturers' agents or representatives in a particular country, are invited to write to the Editor.**

→

EAST AFRICA. A Ransomes platform truck handling cargo at the East African Railway docks at Mombasa, supplied by Ransomes, Sims & Jefferies, Ltd.



↑ DENMARK. A Coles self-propelled mobile tower crane operating at the Port of Aarhus, Denmark.

↓ INDIA. A 50 × 16-in Blake crusher assembled in the Fraser & Chalmers Engineering Works of the General Electric Co., Ltd., for shipment to the Indian Copper Corporation, Ltd., for use in the Masaboni Mine in Bihar State.

FINLAND. British-made International Harvester tractor and Rotavator being used by the Finnish Cement Association at a demonstration at Kangasala. This is part of a campaign to obtain better farm roads and yards by the soil-stabilization method. ↘

*Le matériel britannique de manutention mécanique se trouve en service dans la plupart des pays du monde. Chaque année, depuis la fin de la guerre, le chiffre des ventes à la clientèle des pays d'outremer s'est accru. Des acheteurs venus de tous les pays du monde accourent aux Expositions de la Manutention Mécanique (organisées par notre publication), qui ont lieu tous les deux ans à Londres, si haute est l'estime que l'on a pour le matériel de fabrication anglaise.*

*Dans cet article, à suivre tous le mois, nous vous présenterons des détails succincts et des illustrations du matériel anglais spécialement étudié pour et mis en service dans les pays étrangers.*

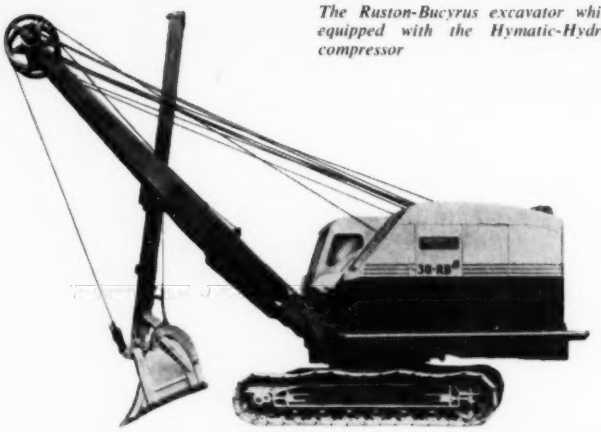
*Nous invitons cordialement les lecteurs de l'étranger à écrire à notre Rédacteur en Chef (The Editor) pous tous renseignements concernant un type quelconque de matériel anglais de manutention mécanique, ou les noms de fabricants, agents distributeurs ou représentants dans un pays donné.*

**En la mayoría de os países del mundo puede hallarse funcionando equipo británico de manejo mecánico. Desde que terminó la guerra la venta de tal equipo a los compradores de ultramar ha venido aumentando sin cesar. Tan considerable es la estima en que se el equipo de fabricacion britanica en todo el mundo, que son numerosisimos los compradores extranjeros que se personan en Londres para visitar la Exposición de Manejo Mecánico (organizada por esta Revista) que se celebra cada dos años.**

**En esta sección, que aparecará todos los meses, les ofreceremos ligeros detalle- e illustraciones de tal equipo británico diseñado para países extranjeros o funs cionando en ellos.**

**Los lectores de ultramar que requiran información sobre cualquier equipo británico de manejo mecánico, o el nombre del agente o representante de los fabricantes en cualquier mais en particular pueden escribir pidiéndola al Director de esta Revista.**

# REVIEW OF NEW EQUIPMENT



*The Ruston-Bucyrus excavator which is now equipped with the Hymatic-Hydrovane air compressor*

## CONCRETE-CARRYING DUMPER BODY

A new and improved concrete-carrying body for the standard Muir-Hill 10B hydraulic dumper is announced by E. Boydell and Co., Ltd., Old Trafford, Manchester. It has been designed to carry concrete between batching plant and site, and is particularly suitable for feeding pavers on road construction projects where the hauling distance is often too short to merit the use of agitators or mobile mixing plant. The new body has a liquid capacity of 2 cu. yd. when operating on a 1 in 10 gradient, and is thus ideal for use in conjunction with 1 yd continuous mixers.

The dumper is arranged to provide a tipping height of 4 ft 6 in under the body lip—a height suitable for discharging into standard 1 and 2 yd concrete Tremie buckets and concrete pump hoppers. The tipping angle between the floor and the body at maximum tip is 56 degrees. A vibrator unit, supplied as an extra, may be fitted to the underside of the body mouth to facilitate slow discharge with the body partially tipped. For concrete placing and similar operations a chute may be fitted to allow the concrete to be discharged at ground level.

## ROTARY AIR COMPRESSOR FOR RUSTON-BUCYRUS EXCAVATOR

The belt-driven Hymatic-Hydrovane air compressor manufactured by the Hymatic Engineering Co., Ltd., Redditch, is now being fitted to the Ruston-Bucyrus 30 R.B. excavator for actuating the main operations of hoist, crowd and swing. Ancillary controls, including swing and propel brakes, steering clutches and shovel dipper trip are also pneumatically operated.

Of the rotary, oil-sealed sliding-vane type, the Hymatic-Hydrovane compressor is almost frictionless, stresses are low and wear negligible. Air flow is smooth and continuous and the compression cycle is more efficient than any equivalent reciprocating compressor, giving a volumetric efficiency of 80 per cent.

Oil is injected during the compression cycle by the pressure of the delivered air, without the need for a circulating pump. Oil separation is so efficient that the delivered air is actually cleaner than with most reciprocating compressors; any traces of air reaching the delivery air filter are returned to the air intake and so back into the lubricating system. Separation takes place while the air is still at a temperature above its dew point, and so water vapour cannot condense and be returned to the sump with the oil. A centrifugal fan in conjunction with an efficient oil cooler permits the air to be cooled during compression by the thermal capacity of the oil. Pressure control is through a servo-operated unloader valve. By this means the compressor pumps only sufficient air to replace the current demand, thus reducing the power required. The response rate is sufficiently fast to eliminate need for air storage capacity, and thus only a moisture separator is used in the delivery line.

## SAMPLE SCREENING

A new machine for the more efficient determination of size consist of coals introduced by Birtley Engineering, Ltd., Birtley, is based on a similar one specially built for, and operated satisfactorily by, the National Coal Board. It consists of a fabricated-steel frame with a single screening surface and totally enclosed drive. Overall dimensions are: length 10 ft, width 2 ft, height 3 ft 5 in.

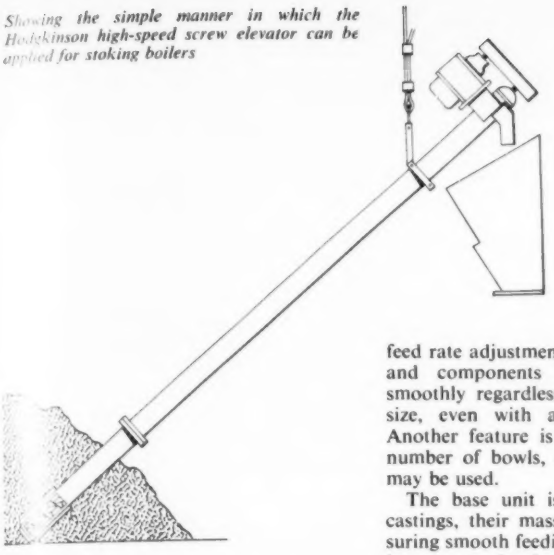
Rollers fitted to the underside of the screen tray and operating on cam tracks provide the forward feed for the material which, as graded product, passes through the respective screen plates to detachable and transportable containers under the machine. The end of the tray is left open for rejection of oversize which is collected in a similar container. Four of the five screening plates provided can be fitted at any one time. The throw can be easily altered by means of the screwed adjustment on the connecting rod. Access to the 1-h.p. drive motor is achieved by removing the front panel and top guard.

The capacity varies with the material and its condition. Tests have indicated that with coal in sizing consist of 0-$\frac{3}{16}$ in, 20 per cent; $\frac{3}{16}$-$\frac{1}{2}$ in, 35 per cent; $\frac{1}{2}$-1 in, 30 per cent; and 1-2 in, 15 per cent. With

*(Left) The Birtley sample screening machine*

*A tipping height of 4 ft 6 in is provided under the lip of the new concrete-carrying body of the Muir-Hill 10B hydraulic dumper*

*Showing the simple manner in which the Hodgkinson high-speed screw elevator can be applied for stoking boilers*



the smallest screen plate having ⅛ in square holes, the screen will handle about 15 cwt/hr when the moisture content is about 10 per cent. If the bulk of the material to be sized is less than ¼ in, with considerable moisture, the throughput will be low.

### HIGH-SPEED SCREW ELEVATOR

For handling boiler house smalls where it is not convenient or possible to prepare a concrete ground hopper or pit, James Hodgkinson (Salford), Ltd., have developed a high-speed screw elevator, ideal for feeding hoppers of 'Low Ram' chain gate or underfeed stokers under such circumstances. It consists of a steel tube in which rotates a worm housed in totally sealed, self-aligning bearings and driven by a constant-speed totally enclosed motor mounted on a platform at the head of the casing. A short standard chute extends from the head to which an additional section or breeches piece can be added, with provision for this to be swivelled to suit site conditions. At the tail the worm is exposed for the entry of coal. An adjustable device permits the head to be supported from any convenient structure.

Each unit will handle up to 1½ tons of smalls/hr and feed direct to the stoker simply by resting the tail on a pile of coal and lifting the head into position over the stoker hopper. The elevator is entirely self-cleaning, and no running maintenance is required since the bearings are grease-packed and sealed for life. Costly erection expenses and delays are eliminated and the machine can be working within half an hour of delivery. The elevator is supplied in standard lengths of 13, 14, 15, 16, 17 and 18 ft.

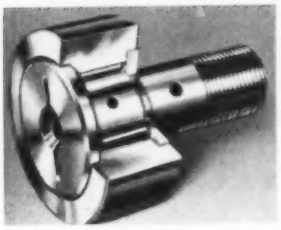
### VIBRATORY HOPPER

The new Hamilton vibratory hopper has been designed to be a more robust unit than is normally available, to ensure smooth and consistent feeding and resist the inertia of the feeder bowl to its limit and still feed to the last component. Mechanical and electrical oscillations and feed rate adjustment have been combined and components are passed through smoothly regardless of weight, shape or size, even with a high delivery rate. Another feature is its versatility as any number of bowls, complete with flights, may be used.

The base unit is made up of sturdy castings, their mass and deployment ensuring smooth feeding even when location is poor or unlevel. Three legs with rubber feet are permanently fitted. In the base casting the heavy-duty armature is arranged for smooth rotation about the hopper axis and is adjusted by a lever brought out through the side wall and locked by an external thumb unit. The pole pieces fixed to the bowl baseplate are of laminated construction to give ideal response to the A.C. current impulses. The gap between them and the armature can be adjusted where the component feed rate is outside the adjustment range of the setting lever. Location of the bowl is by three dowels situated on the largest diameter. Removal and fitting is quick by three socket screws which pull the dowels down firmly, ensuring the necessary mechanical coupling.

Manufactured by W. R. Hamilton (Plymouth), Ltd., Tavistock, Devon, the hopper is sold exclusively in Great Britain by William O. Bullock, 43 Prospect Place, Swindon.

*An INA cam follower cut away to show the cage-guided needle roller bearings*



### NEEDLE-BEARING CAM FOLLOWERS

The reliability of cam followers with needle roller bearings is further secured by the cage-guided bearings fitted in INA Needle Bearings, Ltd., INA Works, Dafen, Llanelly. The cage guarantees accurate guidance of the rollers and their maximum carrying capacity so that the true characteristics of the cam follower can be defined with the assurance that the stated capacity is correct.

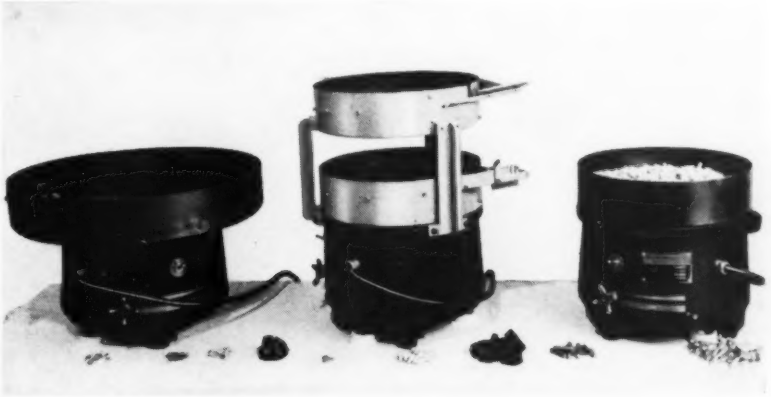
All running and thrust faces of the cam followers are ground to a fine microfinish. Lubrication is by grease nipples, push-fitted into one or both ends of the bolt. Should only one be required, the other end can be plugged with lead, copper or brass. Provision is also made for lubrication through a hole in the bolt shank. Its position is marked on the bolt head and this point must be kept in the unloaded area of the bearing.

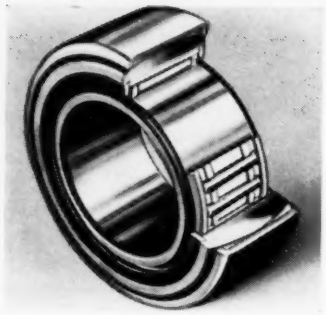
The inch series of cam followers range from the KR ½ in to the KR 3½ in in steps of ⅛ in up to KR 2 in, and of ¼ in up to KR 3¼ in, the size giving the outside diameter of the roller. The standard thread is B.S.F. with the alternative of U.N.F. A metric series ranges from the KR 16 to KR 90, with all metric dimensions and fine threads, the nuts for which are supplied. The design and production of special cam followers can be undertaken with the help of the INA technical office at Llanelly, free of charge.

The advantages of cage-guided needle roller bearings and self-alignment are combined in the INA self-aligning bearing. It allows a certain misalignment of the shaft due to a feature of construction or deflection of the shaft due to settling of the bearing.

The bearing has a spherically ground outer race assembled into a pressed-steel housing with a plastic insert ground to suit the outer race. The fits recommended for the shaft and housing give just

*Examples of the Hamilton vibratory hopper for handling different sizes and shapes of components*





*Showing the cage-guided needle roller in an INA self-aligning bearing*

sufficient allowance for the shaft to align itself when static, with no rotation between the spherical faces when the bearing revolves. The bearing is supplied with or without an inner race, and ranges from a 12- to 45-mm dia shaft and from a 28- to 62-mm outside dia.

**ALCON PUMP WITH B.S.A. ENGINE**

The 1 in and 1½ in Mark III Alcon pumps were recently offered in this country by Arthur Lyon & Co. (Engineers) Ltd., 6 Carlos Place, Grosvenor Square, London, W.1, with alternative American Briggs and Stratton and Clinton engines, which are much lighter than their British counterparts then available. As a result of co-operation with B.S.A. Motor Cycles, Ltd., home and overseas users can now obtain these pumps fitted with the BS 87-c.c. air-cooled single-cylinder four-stroke petrol engine of 54-mm bore and 38-mm stroke, which develops 1.41 b.h.p. at 3,000 r.p.m. and weighs only 23½ lb complete with 4-pint petrol tank and fittings. The maximum output of the 1-in pump is 1,680 g.p.m. and head, 92 ft. The total weight of engine and pump is only 42 lb, the same as when fitted with the Briggs and Stratton and Clinton engines which develop respectively 1.95 b.h.p. and 2.15 b.h.p. at 3,000 r.p.m.

B.S.A. engine features include a Wico-Pacy flywheel magneto with integral fan, Zenith carburetter, high-duty aluminium-alloy connecting rod, aluminium-alloy piston and cylinder head, starting by pulley and cord, power take-off and air-vane governor. The pump has a die-cast Hiduminium body and three-bladed impeller. Rapid priming is ensured by adequate re-circulation passages, ample priming water and a large chamber for separating air and water, and the system has no valves nor moving parts. The combined unit is mounted on an angle-iron baseplate and is fitted with a carrying handle.

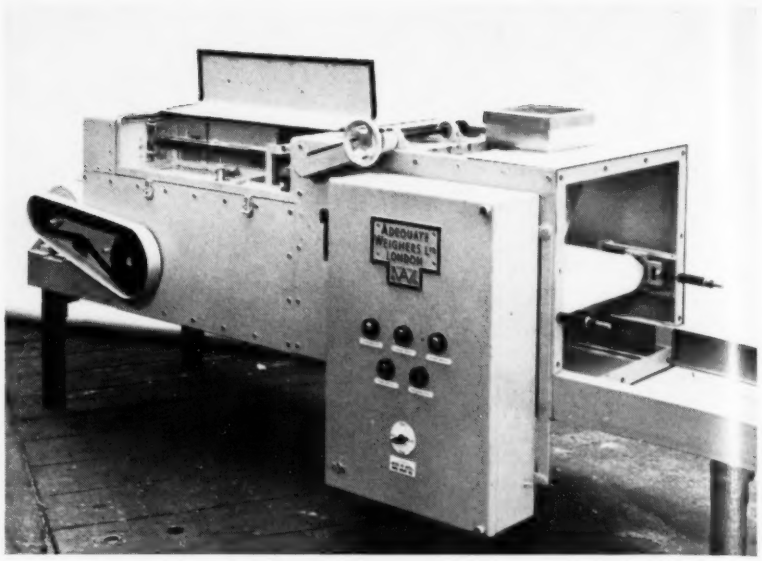
**ELECTRICALLY OPERATED FEEDOMETER**

A new electrically operated Adequate Feedometer, whilst retaining the accuracy of previous mechanically operated machines, has many constructional variations and considerably reduced initial installation costs. It is suitable for continuous process feeding or for battery operation to blend together continuously any number of materials. The electric control relay equipment is contained in one cabinet with the main starting contactor for the motor drives. Visible indicating signals, start and stop push-buttons and isolating switch are mounted on the front hinged cover.

Sensing of the weigh system is accomplished by intrinsically safe circuits of electronic relays. When energized, these operate additional relays which, in turn, feed two adjustable timing units and provide electric interlocks in addition to those mechanically operated. The timing units operate the reversing contactor for the feed control motor, which is driven intermittently until weight error is satisfied by correction to the material feed. Additional switches and relays stop the feeder in the event of failure or flooding, and if the auto-feed control expires in either direction. Visible signals are given and contacts are provided for audible alarms.

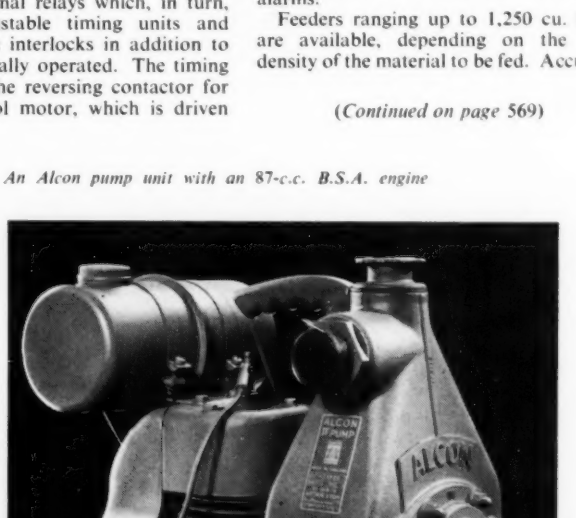
Feeders ranging up to 1,250 cu. ft./hr are available, depending on the bulk density of the material to be fed. Accuracy

(*Continued on page* 569)




*The new electrically operated Adequate continuous Feedometer*

*An Alcon pump unit with an 87-c.c. B.S.A. engine*



varies according to output and nature of material, but an average working figure is plus and minus 1 per cent over a 2-min period.

A high-grade belt with rubber or PVC carrying surface to suit the material is supported on ball bearing idlers and terminal pulleys running in self-aligning and self-lubricating ball bearings. The tail pulley is mounted on a spring-controlled tension unit. The standard machine has an open belt with only the sensitive weighing and electrical control systems in dust-tight compartments. The complete machine can, however, be completely enclosed. For free-flowing materials and powders gravity feed from a hopper is used and automatic control regulates the stream depth. Agitating devices or a variable screw feeder is fitted for materials which do not flow so freely. A variable-speed belt is used, particularly with larger-sized materials. A control unit regulating device prevents hunting, and an automatic cut-out gives a signal warning of feed failure. Electronic or pneumatic remote control can be provided. The part of the machine regulating the feed can also be used in conjunction with the Adequate continuous conveyor weigher. Adequate Weighers Ltd., Bridge Road, Sutton, Surrey.

## TRADE NOTES

### Production Engineering Show

Automation will be the theme of most exhibits at the Production Engineering Show held in Chicago from September 6th to 16th, 1960. This exposition, twice the size of the one held five years ago, will cover both sections of Chicago's Navy Pier and will run concurrently with the Machine Tool Show at the International Amphitheatre. Both shows will be managed by Clapp & Poliak, Inc., of New York. The $10,000,000 exhibit at Navy Pier will show the equipment and products which keep machine tools running. Control equipment, machine components, auxiliary equipment and supplies, intra-plant communications, safety equipment, materials handling equipment, inspection and gauging equipment, testing equipment, and many types of special production equipment will not only be shown but demonstrated under simulated factory conditions. Many of the controls and other auxiliary equipment exhibited at the Production Engineering Show will be used by exhibitors at the Machine Tool Show to keep the machine tools running there. Thus, visitors will be able to inspect the equipment at Navy Pier and see how it works when attached to huge machine tools at the International Amphitheatre.

### Selwood Now Agent for Bray

Bray Construction Equipment, Ltd., Feltham, Middlesex, have appointed William R. Selwood, Ltd., Chandlers Ford, Nr. Winchester, sole agents in Hampshire, Wiltshire, Dorset, Somerset and Berkshire for their hydraulic loading shovels.

### Big Export Orders for Auger Conveyors

Orders for 1,100 Mayrath screw conveyors have been received by Gordon Felber & Co., Ltd., Spirella House, Oxford Circus, London; 850 are being shipped to Australia and the rest to Italy. The conveyors will be used for the handling of grain and light granulated industrial materials.

*Progress on the building of the Doncaster dual-carriageway bypass has been speeded considerably by the use of lorry-mounted cranes for the placing of the bridge beams on the Harworth flyover. Tarslag, Ltd., of Rotherham, used two cranes—a 50-tonner with a 50-ft jib, and a 25-tonner with a 30-ft jib—to lift 18 precast, prestressed beams into position. Each beam was 78 ft long and weighed 36 tons and the lifting time for each, including off-loading and positioning, was one hour. The complete operation was finished in three days. The beams were supplied for the flyover by Ferro-Concrete and Stone (North Notts), Ltd. The main contractors for the motorway are Sir Robert McAlpine & Sons, Ltd. This photograph shows the first beam placed in position*

### IH Tractor to be Made in Spain

Under an agreement just concluded between International Harvester Co. of Great Britain, Ltd., and S.A. de Construcciones Agricolas of Sevilla, a version of the IH B-275 tractor is to be manufactured under licence in Spain. Marketing will be carried out jointly through the existing IH affiliate and its distributor organization in conjunction with the new manufacturers' own retail outlets.

### Turner Manufacturing Co., Ltd.

The above company, of Wulfruna Works, Villiers Street, Wolverhampton, are increasing their capacity by building a new factory at Fordhouses on the outskirts of

*G. L. Robertson (left), Export Sales Manager of Caterpillar Tractor Co., Ltd. (U.K.), Caterpillar Foreign Trade Group, attended the Sales Management Conference in Peoria, Illinois, the headquarters of the parent company, Caterpillar Tractor Co., early in June. He is seen here at a buffet dinner with C. P. Hargreaves (centre), of Sotreq S.A. de Tractores e Equipamentos, and Harold Polland (right), Director of the Brazilian Road Association*

*Developed by Tunny Cranes, Ltd., of London, this hydraulically operated 2-ton crane is mounted on a Thames Trader 4-ton chassis which is specially shortened from 138 in W.B. to 108 in W.B. and powered by the Ford-made 4-cylinder diesel engine. By shortening the wheel base of the truck it is possible for the crane to pick up loads directly in front of the cab as well as at the sides and rear. All controls for the crane are mounted inside the cab above and to the rear of the passenger's seat. A special extension has been mounted on the roof of the cab so that the operator can stand comfortably while operating*

Wolverhampton. With the increased capacity that will be available and the machine tool facilities that they are prepared to add, the company is ready to discuss long-term collaboration with firms who are planning to increase their output, or, alternatively, overseas firms who wish to establish production in this country.

**Two New Institution of Works Managers' Branches**

Due to the steadily increasing membership of the Institution of Works Managers, 196 Shaftesbury Avenue, London, W.C.2, it has been decided to make a planned division of the huge London Branch of the Institution into a number of independent branches. The first two branches approved by the Institutions' Council are the Bucks and Berks Branch and the East Surrey and Sussex Branch. It is intended that six or seven more new branches will be created during the next few years.

One of the prime functions of the institution is the education and training of future works managers. The I.W.M. training course is already being held at Slough and it is intended to start courses at High Wycombe and Crawley in September next. These are in addition to the courses run in other parts of the country.

**Site Shotblasting (Gt. Britain)**

R. J. Richardson & Sons, Ltd., of Birmingham 1, have recently formed a new division, to be known as Site Shotblasting (Gt. Britain). This division has been formed to take care of the shot blasting on site of work too large to be catered for by transport into their works, such as the internal cleaning of large-bore pipes, oil tanks, gasometers, bridges, steel chimneys and large fabrications. A competent staff, under the personal supervision of a site manager, is available to undertake this work.

**£½-million Worth of Crane Controls**

In the first five months of this year, Brookhirst Igranic, a company in the Metal Industries Group, has topped over £½-million worth of orders for crane-control gear. The latest order, worth over £100,000, is for a further 23 sets of electrical controls for cranes at the new Richard Thomas and Baldwins' Spencer Works at Llanwern, near Newport.

**Rotork Engineering Co., Ltd**

At a recent demonstration, Rotork Engineering Co., Ltd., of Bath, Somerset, introduced their new range of electric actuators. The actuators are supplied totally enclosed weatherproof, or alternatively flameproof. The switch compartment as well as the motor is covered by a Buxton Certificate for gas groups I, II and III. Fully flame-proof actuators are now used by major oil companies throughout the world, while the weatherproof version finds increasing application in power stations, waterworks, chemical, steel and many other industries.

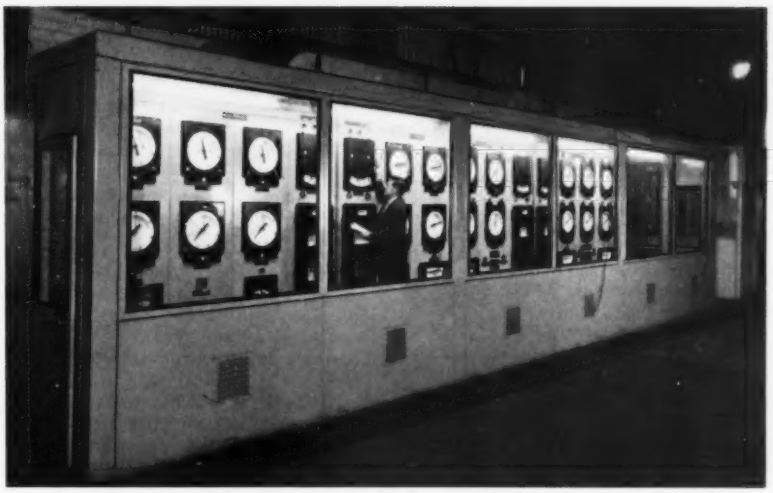
Rotork also offer a consultancy service to valve manufacturers on any problems connected with motorization, and have recently completed agreements with three large Continental firms to manufacture their wide range of actuators in France, Germany and Italy.

**Savings Made by Fork Lift Truck**

Matbro fork lift trucks have been used for many years in the concrete product industry and the production of the new Series III model opens up still wider fields in connection with concrete production. When the New Process Breeze Slab & Mortar Co., Ltd., of Rainham, Essex, had a particular problem in production due to ground conditions in their yard and difficulty of entry into the main building and local shortage of labour, it was

(*Continued on page 571*)

*The Massey-Ferguson Industrial Tractor and Shovel and Digger Unit was a leading feature of the company's stand at the British Exhibition, New York, where items of Massey-Ferguson's British-built equipment drew high praise from visitors from many countries*



*New instrumentation now automatically controls four furnaces at William Beardmore & Co., Ltd., Glasgow. They are two Brayshaw 4- and 6-zone recirculating furnaces and two Priest 4- and 6-zone direct furnaces. The control panel, which is contained in an air-conditioned enclosure, includes Honeywell temperature, combustion and pressure control, with Kent flow metering. Installation and commissioning of the panel was carried out by Honeywell Control Ltd.*

suggested that a fork lift truck would solve these problems. A demonstration of the Matbro Series III fork lift truck, which retains the large-diameter pneumatic tyres used on the earlier Series II machines but also has a much greater manœuvrability, proved this to be correct. At the initial demonstration it became clear that even in wet weather this fork truck was not likely to bog down, and the churning effect of the tyres on the yard surface was greatly reduced because of their large diameter and width. According to the user, the Matbro is a machine which can meet his requirements because of its large-diameter pneumatic tyres, combined with indoor manœuvrability.

### B.S.3214 : 1960 for Plugs and Locking Sockets

When B.S.74, 'Charging plugs-and-sockets for electric battery vehicles' was issued in 1949, it met the needs of industry for standardized fittings up to 150 amp rating. A requirement has now arisen for fittings of this increased rating, not only for charging but also for main traction current duties, and it is with this in mind that the present specification has been prepared.

The new standard covers a 300 amp rating, with a maximum of 125 V. However, under normal service conditions the fittings are used on extra-low voltages: not exceeding 30 V A.C. or 50 V D.C. and no earthing connection is required. Sections of the standard give both general requirements and details of the construction of the plug and locking socket. There is also a section laying down high voltage (routine), temperature rise, mechanical drop and contact pressure tests, and nine figures illustrating the construction and operation of the plugs and sockets, with the dimensions necessary to ensure interchangeability.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

### The Amstel Club

Ten European countries are now represented in the Amstel Club, the organization of finance houses which have entered into reciprocal agreements with each other to provide credit facilities for exporters and importers in the countries concerned, namely Austria, Holland, Western Germany, Sweden, Switzerland, France, Belgium, Italy, Norway and the United Kingdom. It can now be announced that the United States will also be represented in these reciprocal arrangements, through the medium of the Commercial Credit Co., of Baltimore, who have joined the Amstel Club.

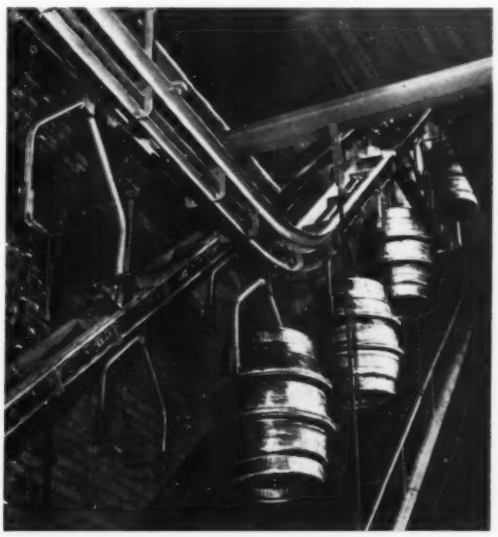
### Ford's New Factory

Work has now started on the 362-acre site of the new £28 million Ford factory at Halewood, Merseyside. The first stage will involve construction of a 2,605,000-sq. ft. factory, employing 8,000 to 9,000 people for the production of 200,000 cars a year. This plant will undertake all body-manufacturing operations—from the stamping of panels to final assembly.

*Teleflex N.V., the Dutch associate of Teleflex Products, Ltd., of Basildon, Essex, has recently completed an installation in the Heineken Brewery in the Netherlands. Three different sizes of empty beer casks, 20, 35 and 50 litres, have to be conveyed from the cleaning machines on the top floor to the filling stations in the basement; the conveyor which will be used for this job is a standard Teleflex dual-directional overhead chain type, handling casks at the rate of 300 an hour, but designed so that, with a minimum of modification, the capacity can be doubled.*

*The casks travel at an approximate speed of 20 ft/min and automatic loading and unloading devices have been designed by Teleflex using Martonair compressed air equipment*

*Matbro Series III fork lift truck, returning pallet boards to the stack at New Process Breeze Slab & Mortar Co., Ltd. Note the rough and muddy ground*



# PUBLICATIONS RECEIVED

**Honeywell Micro Switches**
The latest catalogue issued by Honeywell Controls, Ltd., of Ruislip Road East, Greenford, Middlesex, describes their range of heavy-duty limit switches.

**DCMC Industrial Aerosols**
The above booklet gives full details and specifications of the first comprehensive range of aerosol packed industrial products, including colour coding paints, silicone mould release, rush inhibitor, all-purpose solvent, degreasing fluid, etc., and shows how the aerosol method is being applied in many industries. Copies are available from DCMC Industrial Aerosols, 2a Parkhurst Road, London, N.7.

**Laporte Industries, Ltd.**
The annual report and accounts of the above company of Hanover Square, London, W.1, have been produced in illustrated form, and a lavishly produced 70-page booklet entitled 'The Raw Materials of Progress' describes the company, its history and activities.

**Ayrshire Industrial Brochure**
Ayr County Council have issued a small brochure, in colour, aimed specifically at industrialists interested in expansion of business in an endeavour to interest them in the industrial possibilities in Ayrshire. Copies are available from the County Planning Officer at Ayr.

**Eimco**
A set of release and photographs covering some of the major features of the Eimco 103 line of 100-h.p. diesel engine crawler-tractors has recently been produced by The Eimco Corporation 634-666 South Fourth West Street, Salt Lake City 10, Utah, U.S.A.

**Association of Consulting Engineers**
The report of the Council for the year ended April 30th, 1960, has recently been issued by the above Association of Abbey House, 2 Victoria Street, London, S.W.1.

**Inco-Mond Magazine No. 14**
The latest edition of Inco-Mond Magazine features an article on fertilizer production, illustrating how nickel containing 18/8 stainless steel, due to its corrosion-resistant qualities, proves to be the ideal material for many of the major components in the manufacturing process. Further articles include 'World's Largest Nickel-Aluminium-Bronze Propellor' and 'V-Drive Marine Gears'.

**Cleaver-Hume Press 1960 Catalogue**
Cleaver-Hume Press, Ltd., a company in the Cleaver-Hume Group, have recently issued their complete Catalogue for 1960. Copies available from 31 Wright's Lane, Kensington, London, W.8.

**W. W. Brown & Partners, Ltd.**
The above company of 72 Newman Street, London, W.1, have recently introduced a new range of standard loading hoppers which are suitable for most bulk materials and are discharged by means of motorized belt feeders. Leaflets are available giving fuller details.

**Harvester Round**
The spring 1960 issue of the above publication describes the latest activities and developments of the International Harvester Company of Great Britain, Ltd.

**Self-Changing Gears, Ltd.**
These manufacturers have produced a new booklet entitled 'Mechanical and Hydraulic Drive' which covers the uses of gearboxes, fluid couplings, torque converters and final drives for industry. This edition should be of particular interest to engineers and designers and copies are obtainable free of charge from Self-Changing Gears, Ltd., Lythalls Lane, Coventry.

**U.S. Industrial Digest**
The April 1960 number of the above periodical details industrial information from U.S. manufacturers published for international editors.

**Machine Tools**
Issue No. 19 of the above publication released by A. A. Jones & Shipman, Ltd., details their precision finishing and productivity, with special reference to their stand at the International Machine Tool Exhibition.

**Simon Handling Engineers, Ltd.**
In a well-produced, illustrated brochure, the above company of Cheadle Heath, Stockport, Cheshire, describe some of their interesting installations which are at work all over the world.

**Co-operation at Wandsworth**
A new brochure, entitled as above, which has recently been issued by Henry Simon, Ltd., Cheadle Heath, Stockport, describes a new Feed Mill at Wandsworth for J. Bibby & Sons, Ltd.

**The Incandescent Heat Co., Ltd.**
The above company of Cornwall Road, Smethwick, Birmingham, have produced a new leaflet entitled 'Radiant-Jet Furnaces', No. V61.

**Turner Brothers Asbestos Co., Ltd.**
Two new catalogues have been published by the above firm, of P.O. Box 40, Rochdale, both of which deal with the company's belting products. Catalogue No. BA.73 entitled 'Rubber Conveyor Belting' deals with conveyor belting and information regarding conveyor belt installation, operation and maintenance. 'No. BPV.3 "Poly-V" Drives' gives data on service factors, horsepower ratings, pulleys and installation and maintenance instructions. Copies of both publications are free on request.

**Fuel Abstracts and Current Titles**
The Institute of Fuel, 18 Devonshire Street, Portland Place, London, W.1, has recently issued a new publication of the above booklet. This is a monthly summary of world literature on all technical and scientific aspects of fuel and power compiled by the Institute of Fuel.

**The Gourock Ropework Co., Ltd.**
These manufacturers have issued a new steel wire rope manual. This embodies two main sections, the first dealing with the manufacture, handling and installation of steel wire ropes and the second giving weights and breaking strains of all standard ropes normally used. The second section has been tab-indexed for easy reference.

**Getting Together**
Richard Sutcliffe, Ltd., Universal Works, Horbury, Wakefield, have recently published a small booklet entitled as above. This outlines the specific fields of activity of each of their member companies.

**Elcontrol, Ltd.**
This company of Wilbury Way, Hitchin, Herts, have re-issued their Timer Data Sheet TR Issue (3). This new issue includes a new high accuracy unit-type TRU4.

**George Pike, Ltd.**
The above firm, of Alma Street, Birmingham 6, have published a catalogue entitled 'Geopi' Traffic Controls, Catalogue No. 60. Amongst many items of interest are those describing automatic vehicle actuation with portable traffic signals, and illustrations of new types of traffic controls.

**Mechanical Handling Equipment**
The above booklet, issued by the Association of Swedish Manufacturers of Mechanical Handling Equipment, con-

(*Continued on page 573*)


## September

*Among the feature articles this issue will contain the following:—*

**Activity Sampling and the Travel Chart**

**Fully Automatic Control of Paint Shop Conveyors in French Motor Car Factory**

**Tea Handling at a Manchester Warehouse**

**Mechanized Bottling Plant**

**Rubber Suspension for Factory Trucks**

**and usual features**

tains many items and illustrations of interest. In four languages, it is available from the above Association, Stockholm 10.

**Industrial Hydraulics, Ltd.**
These manufacturers, of 101 London Road, Reading, have added three new sizes of hydraulic accumulators to their existing range. A fully instructive illustrated leaflet is available.

**Dock and Harbour Authorities' Association**
The Executive Committee of the above association present the 40th Report of the Proceedings of the Association for 1959.

**Aveling-Barford, Ltd.**
A new catalogue on their 13½-ton dumper has been produced by the above company of Grantham, Lincs. A further comprehensive catalogue on Motor Graders is also available. 'Aveling-Barford News' for February 1960 gives details of the company's wide range of activities and developments.

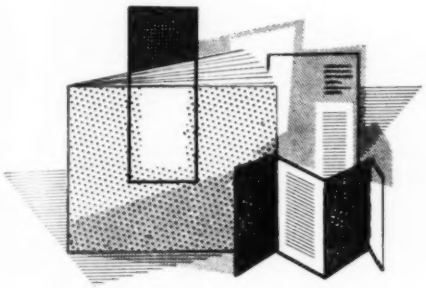
**J. Broughton & Son (Engineers), Ltd.**
The above company, of 'Security' Works, Pershore Road South, Kings Norton Factory Centre, Birmingham 30, have recently released details of their latest development in air cylinders in a 22-page catalogue.

**Oil Retaining Bearings**
The above is the title of a new catalogue published by Bound Brook Bearings, Ltd., Trent Valley Trading Estate, Lichfield, Staffs.

**Timken**
The March 1960 issue of the above journal, published by The Timken Roller Bearing Co. for its employees, gives details of the company's recent activities.

**Year Books**
The 'Electrical Year Book, 1960' and the 'Mechanical World Year Book, 1960' are now available from the publishers, Emmott & Co., Ltd., 31 King Street West, Manchester 3, price 4s. and 5s., respectively.

**The Engineers Buyers' Guide 1960**
The 1960 edition of the above Buyers guide has recently been produced by 'The Engineer', 28 Essex Street, Strand, London, W.C.2.



# ABSTRACTS AND REFERENCES

**Articles on mechanical handling published in all technical and industrial journals of the world are indexed and abstracted below. Whenever it is known, the published price of the journal containing the article is given.**

**The addresses of the publications concerned are given and applications for copies of the journals mentioned should be made direct.**

## RUSSIAN TRANSLATIONS

We publish below the first of a series of abstracts from the Russian technical journal *Mechanizatsia i Avtomatizatsia Proyzvodstva*.

### AUTOMATIC CONTROL OF A CEMENT FACTORY

**Introduction of mechanical handling reduces number of workers required.** Issue No. 1, 1960. Pp. 46-50.

Complete automation of a large cement factory equipped with four mixers of 1,200 h.p. each was achieved upon the perfection of the following: mixers, pneumatic system, limit switches and finally the material level indicators for the hoppers.

The introduction of mechanized handling allowed to reduce the number of workers in the mixing and blending departments to four. Simultaneously it assured an increase of production by 30 per cent. The quality was also markedly improved which resulted in a lowering of cement consumption by 20 kg for producing 1 cu.m of concrete.

The old blending equipment showed some defects. This has made difficult the task of obtaining an automatic production of cement to 10 specifications. The actual output which could be relied upon was only of two types.

On account of a too slow closure of the cut-off gates, control by a number of mercury relays, overspilling of incoming material was unavoidable.

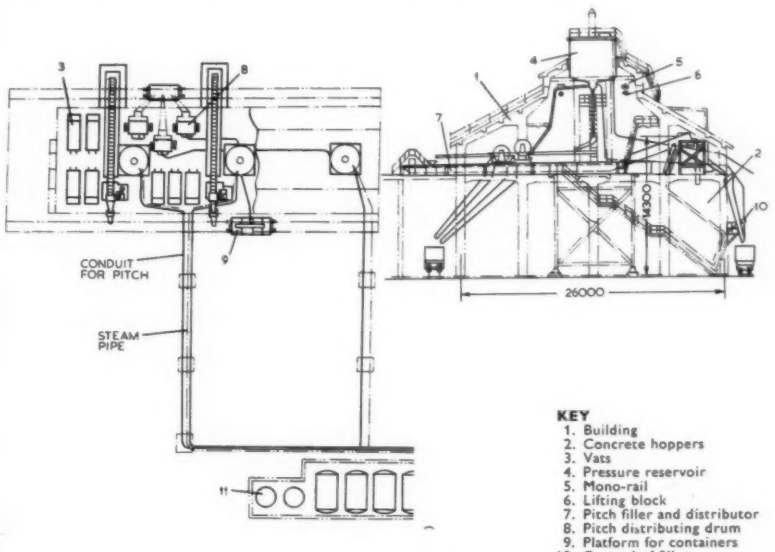
In the modified equipment the mercury relays were replaced by high-speed magnetic-mercury units. The gate closures were considerably improved, leading to a reduction in shuttering to less than $\frac{1}{10}$ sec.

The blending of water and other chemical components in a container was also modernized. In winter the additions were calcium chloride and natrium chloride. In summer some plastificators.

As the reliability of the pneumatic devices is dependent on the air cleanliness, the air feed system was modified. The air compressor with attached dehumidifier and receiver of about 4 m capacity, was placed on the first inclined gallery.

Particular attention was drawn to limit switches. Previously the highly abrasive

*Fig.* 1. *Diagram of pitch-producing and distributing installation* (*see page* 574)




**KEY**
1. Building
2. Concrete hoppers
3. Vats
4. Pressure reservoir
5. Mono-rail
6. Lifting block
7. Pitch filler and distributor
8. Pitch distributing drum
9. Platform for containers
10. Control of fillers
11. Preliminary pitch coolers

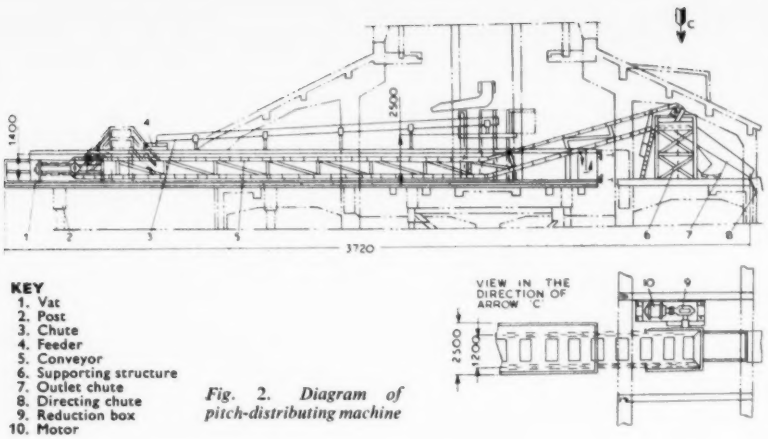



*Fig. 2. Diagram of pitch-distributing machine*

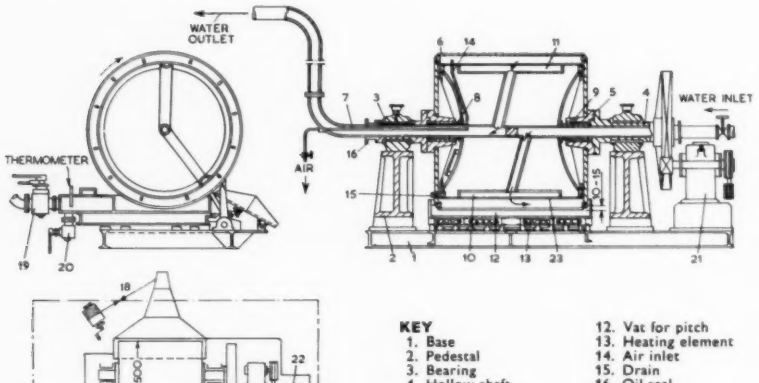



*Fig. 3. Diagram of pitch-distributing drum*

atmosphere caused rapid wear of contacts; there were also frequent failures of springs. The new limit switch secures at least 10 million trouble-free operations.

The control panel of the whole automatic installation consists of two main contactors and 30 relays. Besides, there are signalling panels for the blending and cement delivery operations. Safety provisions are made in order to prevent faulty direction of materials into the mixers. Interlocking is provided for opening gates into the mixer—only when the latter is in a horizontal position.

### MECHANIZED TRANSPORT AND LOADING OF PITCH

*Mechanizatsia i Avtomatizatsia Provzvodstva*, No. 2. Pp. 48, 49 and 50.

A modernized installation for handling pitch is shown in Figs. 1 and 2. It handles an important by-product of the coke industry. The former comes out at a temperature 280-300 deg C and passes into a pressure reservoir. From the latter it is being distributed to four concrete containers which are double walled. This construction allows to provide steam-heating in order to keep the pitch warm and thus facilitates its speedy flow. The arrangement also provides the advantage of prevention of air pollution by avoiding dust from the pitch. From the reservoirs the material is taken into vats filled with water for rapid cooling. This is done by means of a slat conveyor 30·5 m long and 1·2 m wide, having an inclination of about 20 deg at the input side. The drive of the former is by a 10-kW motor and a reduction box with a ratio 1 : 38. The output of the conveyor is 10 ton/hr. Its speed is 0·2 m/sec. Transit time of the pitch in water is 100-110 sec.

A further development has been the introduction of a new filler giving an output of 50-60 ton/day. It consists of a revolving drum (Fig. 3) turning on two short hollow stub shafts. Through the latter a hollow pipe forming an axle is passed, which holds the expeller drum. Cold water is brought into the lower part of the stationary drum and the warm water is drawn out from the upper section. The diameter of the rotating drum is 2,500 mm. Total cooling area 15·5 sq. m. The revolving part is only immersed 10-15 mm in the vat, whose holding capacity is 0·45 cu. m. The vats are electrically heated to 250 deg C. The solidified pitch is taken out from the surface of the rotating drum by scrapers and falls through a chute into the railway wagon. Speed of the drum 2-3 r.p.m. Hourly output 4·5-5 ton, power required 4 kW. Weight of the machine 20 ton.

### SAFE HANDLING OF METAL PLATES

**Plate-Lifting Clamp**, *Power and Works Engineering*, 33 Tothill Street, London, S.W.1. March, 1960. P. 210.

For the safe movement of metal plates in the vertical position along narrow gangways and passages is described the Interlas double-cam operated clamp. It is stated that this is 100 per cent reliable without any danger of the load slipping. The greater the pull, the tighter the cam-operated jaws grip the plate, and when the weight of the plate is taken on the ground, the clamp cannot loosen until a locking lever has been released. When this is released, the clamp pulls away easily on rollers which run on the plate. Clamps are available in seven different sizes to accommodate loads from 1½ ton maximum to 20 ton maximum and plate thicknesses of ¾ in maximum to 3 in maximum.

### FOR LIFTING IN CONFINED SPACES

**Multi-directional Floor Crane.** *Factory*, 330 W 42nd Street, New York 36, N.Y., U.S.A. March, 1960, P. 120.

Designed to save labour and speed up production, a new mobile floor crane described is known as the Herculift Standard. It has a power lift boom that moves up, down and sideways, can be lowered to 1½ ft from the ground and raised to a maximum of 9 ft. Of telescopic construction, the boom can be extended so that the lifting hook reaches 6 ft beyond the front of the crane. Completely counterbalanced, the crane can lift, haul and position loads up to 5,000 lb. It can be operated manually or electrically, with controls on the drawbar handle.

### GEARLESS TRACTOR

**Test Tractor Has No Gears.** *Engineering News-Record*, 330 W 42nd Street, New York 36, N.Y., U.S.A. May 12th, 1960. Pp. 62-63. 50c.

Said to be in an early experimental stage, a petrol-engined tractor developed by the International Harvester Co. is driven hydraulically, having no transmission gearing, drive shaft, differential gear, axles or independent braking system. There are three main elements: a piston pump, high-pressure hydraulic piping system and a pair of 5-cylinder oil-operated radial piston motors mounted on the two rear wheels. A multiple piston pump is attached directly to the rear of the engine. Nine pump plungers extend rearwards to contact a variable-pitch swashplate connected directly to the engine by a shaft running through the centre of the pump.

As the swashplate revolves on the oblique, it cams the plungers inward to give them reciprocating motion that forces oil through the system. As the swashplate pivots about its centre the inward motion of one piston is accompanied by a corresponding outward movement of opposite pistons and a constant pressure is maintained. The oil is circulated to the two radial motors the pistons of each of which are connected to an eccentric which serves as a crank shaft to turn the wheel. Wheel motor speed is

(*Continued on page 575*)

controlled by a single lever that varies the angle of the swashplate. When it is at 90 deg to its shaft, it revolves without applying any camming action to the pump plungers and the tractor is braked. To reverse the direction of travel, it is necessary only to move the control lever past the neutral or braking point to reverse the flow of oil and therefore the wheel motors.

**QUARRYING EARTHMOVING**
**Power for Pushing Scrapers.** By Leo J. [illegible] Jr., *Engineering News-Record*, 330 W 42nd Street, New York 36, N.Y., U.S.A. April 7, 1960. P. 30-33. 50c.

The author first states that emphasis in earthmoving these days is on greater production, larger machines and more power with the object of lowering the cost per yard moved. Thus contractors are using high-powered crawler and rubber-tyred pushers, singly and in tandem, to obtain heaping loads in surprisingly short loading time. In one case, for example, on a large-scale dam project, the contractor teamed two twin-engined crawlers with a twin-engined scraper and had more than 1,400 h.p. available for the fast loading of 27 cu. yd. units.

Achieving a balanced relationship between pushers and scrapers is, he says, a function of the scraper and pusher cycle times and costs. A fundamental relationship is that the number of scrapers handled by a single pusher equals scraper cycle time divided by pusher cycle time. Many factors affect both the scraper cycle time and pusher cycle time. Among others, important variables are pusher size and speed, scraper size and performance characteristics, length of scraper haul, grade resistance, haul road conditions and loading pattern. Reducing time spent in loading will make it possble for a pusher to handle more scrapers in a given time and thus increase production. If the same pusher can handle more scrapers with no increase in cost, production costs will be lower. In conclusion the author states that application of large amounts of power to push loading are most likely to be profitable with large scrapers, long hauls and hard-to-dig materials in combination or singly.

**AUSTRALIAN EARTHMOVER**
**The Ateco Elescraper.** *The Australian Engineer*, 20 Loftus Street, Sydney, Australia, February 1960. P. 65. 7s. 6d.

Of complete Australian design and manufacture, the new Ateco Elescraper, briefly described, is a one-man-operated self-loading scraper unit with an exclusive hydraulically powered elevator which permits 7½ cu. yd. of earth to be loaded on an average of one minute per load. Another important feature associated with the elevator is that all the material handled is thoroughly pulverized, so that each load can be spread thoroughly. It can, it is said, be laid in a layer as thin as half an inch if required.

**WINCHING BY LOADER**
**Wheel Winch.** *Design News*, 3375 S Bannock, Englewood, Colorado, U.S.A. March 28th, 1960. P. 59.

A prototype four-wheel-driven loader that can perform winching operations by cable drums attached to the front wheels is said to have been constructed. With the rear wheel drive disengaged, the front wheels are raised off the ground by lowering the bucket to the extreme crowd position. Winching operations can then be performed under the control of the loader clutch, throttle and brake. The cables pass through guides on each side of the bucket, which forms a positive anchor as its cutting edge digs into the ground when winching commences. When not in use, the cable hooks are secured to the drums by tension springs.

## RECENT PATENTS

**The following are brief extracts of recent United Kingdom patents which we believe will interest our readers. For full details the original patent specifications should be consulted at, or bought (3s. 6d. each) from, The Patents Office, Southampton Buildings, Chancery Lane, London, W.C.2.**

**REFUSE COMBUSTION**
**P. Vago, of Buenos Aires—U.K. 823568.**

Handling method for damp refuse combustion, with iron magnetically removed, and non-combustibles removed by pneumatic separation. Boiler gases heat the mass to 100 deg C removing water, with automatic regulation of gas heat content to mass conveyed from hopper.

**ARTICLE FEED**
**Wm Wrigley, Jr. Co., of Chicago—U.K. 823869.**

Automatic control of conveyor handler wherein the action is stopped if the small objects, e.g., chewing gum bases, get displaced, avoids dislocation of equipment by stickage.

**HOSE GUIDE**
**Yale & Towne Manufacturing Co., New York—U.K. 823903.**

Spring system to maintain tension in a hose and reel system for lift trucks, with a reel guide not upset by the hydraulic pressure.

**ROCK MOVEMENT**
**F. J. Walls, of Dublin—U.K. 823935.**

Tree stump or rock movement using a tractor or dozer attachment with the beam and lever under hydraulic control using pulleys and articulation.

**STOCK TRANSPORT**
**J. W. Ludowice, of Germany—U.K. 823939.**

Method of fixing stack of material on carriage or rail support using pivoted handlers.

**BOTTLE CONVEYOR**
**G. L. N. Meyer, of Milwaukee—U.K. 823952.**

High speed bottle transport for washing and conveying, at 450 per minute, whilst avoiding any falling over-using series of rows combined by an accelerator near the end.

**CARTON SEALING**
**Embart Manufacturing Co., of Hartford, Conn.—U.K. 823972.**

System of compression units for sealing glued carton flaps between conveyor rollers, for a range of sizes.

**LOADER**
**National Broach & Machine Co., of Detroit—U.K. 823985.**

Automatic transfer machine or loader design for gear shaving equipment.

**GRAIN CONVEYOR**
**P. Lea, of Crewe—U.K. 823995.**

For use from grinders to storage bin aiming to avoid undue wear and working at different flow rates as desired. Drag links are used with paddles in the chute through which air mostly from the grinder, passes, largely along the return path conveyor passage.

**MINING**
**W. Heidemann, of Bochum—U.K. 824053.**

System of trough transporter and scraper chain which ensures good loading, by use of a stuffer to give a good full height of stack by fluid power.

**BREAD CONVEYOR**
**American Machine & Foundry Co., of New York—U.K. 824060.**

Can deal with varied lengths of articles for bread wrapping, etc., using a given form of bevel gear and sprocket on the chain conveyor.

**GRANULE COOLER**
**Metallgesellschaft A.G., of Frankfurt—U.K. 824074.**

A granule cooler with minimum dust carry off, e.g., of roasted ores ex a cyclone, being reduced from 1,000 deg C to 150 for conveyor carriage, and avoiding water cooling. Air blows through a vibrated vertical helix to treat say 3,000 tons a day—the heat being used, e.g., as preheating for the furnace.

**LETTER CONVEYOR**
**Pinney Bowes Inc., of Stamford, Conn.—U.K. 824076.**

A small parcel selector device for use in conveyorized pidgeon holing, which avoids selection at each deposit point, i.e., is quicker, and uses a moveable support with fingers which only operate when they all engage sensing devices at the stop points.

**TRANSFER CONVEYOR**
**Rose Brothers Gainsborough, Ltd., of Lincoln—U.K. 824134.**

Transfer feed having feeler to stop belt motion during transfer and prevent over ride, e.g., of frozen food packages.

**CHIPLET FEED**
**Abitibi Power & Paper Co., of Iraquois Falls—U.K. 824146.**

Dispenser feed for board making from wood shavings and splinters, with even density layer of binder coated material assured by sets of pairs of rotary plates on axles in fall from hopper to prevent light chips being concentrated in layers on conveyor below.

**TOBACCO HANDLING**
**Brown & Williamson Tobacco Corporation, of Kentucky—U.K. 824154.**

Machinery performing threshing on

tobacco, with air separation and a given form of band conveyor of paddle thresher.

**STREET SWEEPER**
**K. H. Schortig, of Hanover—U.K. 824160.**

Road refuse sweeper using a main cylindrical brush and suction conduit leading from it to a tiltable hopper, for storage and dumping. Disc shaped brooms in front sweep either gutter as required.

**WINCH**
**National Research Development Corporation, London—U.K. 824178.**

A cable guide, formed as a barrel-shaped roller, which may be tapered, avoids whip and associated troubles if cable tension is suddenly reduced.

**ASPHALT ROLLER**
**F. W. Livermort, of Monrovia, California—U.K. 824197.**

A road surface, etc., compactor using two sets of four rollers running on false axes.

**HYDRAULIC HOIST**
**Metallwerke Glockerbau G.m.b.H., of Donau—U.K. 824279.**

Design with axial piston pump and variable fluid delivery, under automatic control to avoid excess power to the servo motors.

**RAIL TUB RETARDER**
**Coal Industry Patents, Ltd., of London—U.K. 824318.**

Mine tub retarder avoiding undue shock, with a run-on platform, pivoted to allow slow sinking and run-off, using a dash pot type cylinder.

**CAP HANDLER**
**E. Busi, of Italy—U.K. 824379.**

Conveyorized punch system for blanking out paper, etc., inserts and affixing to cork, using an endless chain disc conveyor.

**GRIT HANDLER**
**A. Scroder, of Munich—U.K. 824424.**

A lorry for scattering grit, using a slatted conveyor belt feed on to the opposed double-screw sprayer device, at the front, the whole being removeable.

**SEGREGATOR**
**H.M. Postmaster-General—U.K. 824565.**

Rotating drum for separating articles by size, e.g., postal packets and letters, using an inner set of overlapping flaps, the output passing to a conveyor feeding a sort and marker.

**STEERING**
**Yale & Towne Manufacturing Co., of New York—U.K. 824590.**

Industrial truck geometric steering arrangement using simple gears for the pair of wheels, and a cam arrangement.

**GRAIN TURNER**
**Maison Vaneaspel of Brussels, in B.P. 824743.**

Relate a design of grain turner using paddles on arms, some of the paddles being reversible, yet avoiding any crushing action and able to move thick beds of grain. The paddles, etc., can be radiation sterilized.

**BUSH UPROOTING**
**J. E. Hollebone, of Surrey—U.K. 824817.**

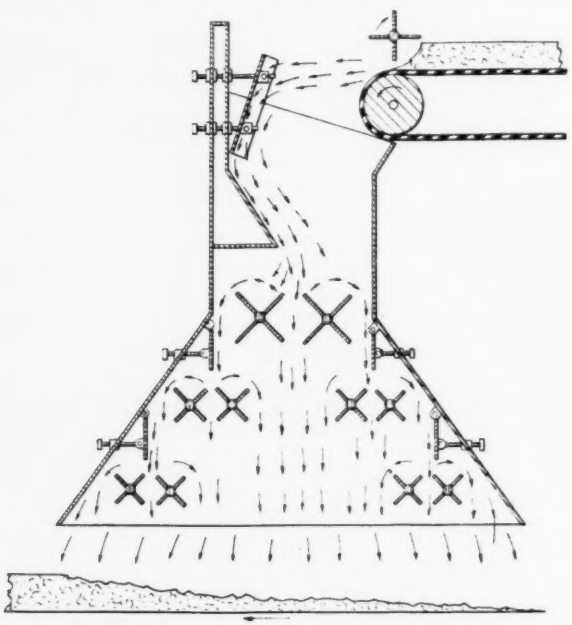
Suggest a land clearing device, improved on patent 824068, comprising a tractor attachment with jaws pivoted on a slider and having power lift.

**LOOSE FEEDER**
**Proctor & Schwartz, Inc., of Philadelphia—U.K. 8248578.**

Reversible conveyor feeding several cigarette making machines, by incremental movement at a uniform height and amount for each hopper with blowers providing the main occasional feed.

**WASHING PLANT**
**Watney, Mann, Ltd., of Pimlico—U.K. 824962.**

Conveyorized plant with regular stepwise movements, and vertical reciprocation with liquid injection at the washing stops, followed by drainage, all under pneumatic control. Suitable for cleaning aluminium beer barrels.



*Chiplet feeder. Ref. U.K.*824146

**CONVEYOR CHAINS**
**D. M. King, of Stevenage—U.K. 824981.**

Made from flat links and pins, as welded loops of U or J-shaped identical shapes.

**FLEXIBLE BARGES**
**Dracone Developments, Ltd.—U.K. 82498[illegible].**

For handling liquid and fluidized products of improved stability, achieved by adding water if desired to some compartments.

**MINE CAR**
**W. H. Barker & Son, Engineers, Ltd., of Stoke-on-Trent—U.K. 825019.**

Patent 802630 is improved for retarding free running mine cars using a chain and pad engaging the cars, being shaped partly cylindrical and partly flat.

**SLING**
**Yacht & Commercial Rigging Co., Ltd., of Isleworth—U.K. 825065.**

For crane off-loading, to avoid the load spreading as it rests on the ground, using a given form of saddle plate and pivoted clamp with the sling.

**FLOATING CONVEYOR**
**J. Moar, of Alberta—U.K. 825068.**

Ore and gravel conveyance using a water flume to give minimum wear and cost, with the conveyor floating in the water, centralized by vertical side rollers. Float chambers are included in the conveyor at the edges or underneath.

**CERAMIC OVENS**
**Shelley Potteries, Ltd., of Stoke—U.K. 825092.**

Improve patent 775108 and relate a form of girder with hoists to lift oven doors or rooves.

**PARTICLE THROWER**
**S. W. Lucas, of Brisbane—U.K. 825113.**

For filling ships holds, etc., by throwing grain or sugar, avoiding belt bulge at high speed, by using wide rollers under pulley control.

**BUNKER CONTROL**
**Elba Werk G.m.b.H., of Boden—U.K. 825119.**

Bowden type cable control for bin opening, etc., when handling tar, concrete, etc., which can be fixed open or shut for long periods.

**CABLE LAYING**
**H. M. Postmaster-General—U.K. 825138.**

Ship handling arrangement with rigid repeater housings to enable by-passing of the paying out drum by means of a set of pulleys.

**COKE HANDLING**
**Koninklijke Nederlandsche Haagovens en Staalfabriken N.V., of Ijmuiden—U.K. 825[illegible]19.**

Discharge arrangement for coke in oven batteries which have an inclined surface leading on to a conveyor, with control by rotating wheels carrying prongs for force feed.

**PIPE HANDLING**
**Percy Bilton, Ltd.—U.K. 825298.**

Large diameter concrete, etc., pipe (e.g., up to 4 ft) is handling by a sliding lift device on a frame with hydraulic jack operation, the whole running on wheels—and even into the already lain pipe if need be.